NOTICE

All drawings located at the end of the document.

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LETTER REPORT
COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
CONSERVATIVE SCREEN
TO DEFINE AREAS OF CONCERN AT
OPERABLE UNIT 3

ROCKY FLATS ENVIRONMENTAL
TECHNOLOGY SITE

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL
TECHNOLOGY SITE
GOLDEN, COLORADO

ENVIRONMENTAL RESTORATION PROGRAM

SEPTEMBER 23, 1994

DEN10016249.WP5

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SECTION Page

TABLES

FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

The following is a list of acronyms used throughout this CDPHE Conservative Screen Report:

BGCR	Background Geochemical Characterization Report
CDPHE	Colorado Department of Public Health and Environment
COC	Chemicals of Concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HHRA	Human Health Risk Assessment
IHSS	Individual Hazardous Substances Site
OU 3	Operable Unit 3
PCOC	potential chemical of concern
PRG	Programmatic Preliminary Remediation Goal
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFEDS	Rocky Flats Environmental Database System
RFETS	Rocky Flats Environmental Technology Site
RFI	RCRA Facility Investigation
RI	Remedial Investigation (CERCLA)
TM	technical memorandum
UCL	upper confidence limit
VOC	volatile organic compound

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The Administrative Record Staff

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This executive summary provides results of the Colorado Department of Public Health and Environment (CDPHE) Conservative Screen for Operable Unit No. 3 (OU 3), located adjacent to the Rocky Flats Environmental Technology Site (RFETS). The CDPHE Conservative Screen was developed as part of the Data Aggregation process used in Human Health Risk Assessments (HHRA) for RFETS by CDPHE, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE) (CDPHE/EPA/DOE, 1994). The conservative screening process is used in conjunction with the chemicals of concern (COC) selection process to identify OU-specific COCs and the areas within the OUs that may be impacted by those chemicals.

The CDPHE Conservative Screen includes the following six steps:

- STEP 1: Define potential chemicals of concern (PCOCs)
- STEP 2: Identify "Source Areas"
- STEP 3: Calculate a risk-based concentration (RBC) for each PCOC
- STEP 4: Calculate a RBC Ratio Sum for each Source Area
- STEP 5: Apply CDPHE Conservative Screen decision criteria to each Source Area
- STEP 6: Define "Area(s) of Concern"

In **Step 1** of the CDPHE Conservative Screen, OU 3 data were compared to background and benchmark data to identify PCOCs for each medium in each Individual Hazardous Substance Site (IHSS) of OU 3. The following PCOCs were identified:

- IHSS 199 (Contamination of Soil): ^{241}Am and $^{239/240}$Pu for surface soil
- IHSS 200 (Great Western Reservoir): $^{239/240}$Pu for surface sediments, strontium for groundwater, and $^{239/240}$Pu and copper for subsurface sediments
- IHSS 201 (Standley Lake): None
- IHSS 202 (Mower Reservoir): None

The purpose of **Step 2** of the CDPHE Conservative Screen is to identify "Source Areas" within OU 3. Source Areas are defined as all sample locations where concentrations (nonradionuclides) or activities (radionuclides) of inorganic PCOCs are greater than upper-bound background values (i.e., background mean plus two standard deviations), and all sample locations where concentrations of organic PCOCs are greater than reported detection limits (CDPHE/EPA/DOE, 1994). Sixty-six soil sample locations were identified as Source Areas by Step 2. Background data were not available to perform this step for PCOCs in IHSS 200, so the entire reservoir was considered as a Source Area for subsequent steps of the CDPHE Conservative Screen.

In **Step 3** of the CDPHE Conservative Screen, RBCs were calculated for each PCOC. The RBCs presented in the Final Rocky Flats Programmatic Risk-Based Preliminary Remediation Goals (DOE, 1994c) were used for Step 3 for OU 3. The RBCs are based on a residential exposure scenario for soil, sediments, and groundwater.

In **Step 4** of the CDPHE Conservative Screen, maximum detected concentrations or activities of the PCOCs in each medium were compared to the RBCs. The following RBC Ratio Sum was calculated for each Source Area:

$$RBC\ Ratio \sum = \sum_{j=1}^{m} \sum_{i=1}^{n} (maximum\ concentration\ or\ activity_{ij} / RBC_{ij}))$$

where

RBC = risk-based concentration

j = medium

i = PCOC

maximum concentration or activity = maximum concentration or activity in the Source Area

Three of the surface-soil Source Areas identified in Step 2 have RBC Ratio Sums greater than 1. The RBC Ratio Sum for Great Western Reservoir (sediments and groundwater) is also greater than 1. All other Source Areas for OU 3 had RBC Ratio Sums less than 1 (i.e., 63 surface-soil locations).

In **Step 5** of the CDPHE Conservative Screen, the following decision criteria were used to determine further action for Source Areas:

- If the RBC Ratio Sum for a Source Area is greater than or equal to 100, DOE may conduct a Voluntary Corrective Action for that portion of the OU.

- If the RBC Ratio Sum for a Source Area is between 1 and 100, DOE must conduct an HHRA for that Source Area, in accordance with Risk Assessment Guidance for Superfund (EPA, 1989a).

- If the RBC Ratio Sum for a Source Area is less than or equal to 1, no further action is required pending an evaluation of dermal exposure.

All RBC Ratio Sums for surface-soil Source Areas in OU 3 are either less than 1 or in the 1 to 100 range. The three surface-soil Source Areas with RBC Ratio Sums between 1 and 100 require further evaluation in a HHRA. The surface-soil Source Areas with RBC Ratio Sums less than 1 require no further action. For those surface-soil Source Areas with RBC Ratio Sums less than 1, a screening for dermal exposure (i.e., comparison of maximum activities to Dermal RBCs [RBC based on exposure via dermal absorption]) indicated dermal contact with soil is not a significant exposure pathway for OU 3.

The RBC Ratio Sum for Great Western Reservoir is greater than 1; therefore, this Source Area requires further evaluation in a HHRA. IHSSs 201 and 202 require no further action; RBC Ratio Sums were not calculated for these reservoirs because no PCOCs were identified for Standley Lake or Mower Reservoir.

"Areas of Concern" for OU 3 were identified in **Step 6** of the CDPHE Conservative Screen. Areas of Concern are defined as one or several Source Areas grouped spatially in close proximity (CDPHE/EPA/DOE, 1994). In the HHRA for OU 3, the three surface-soil Source Areas with RBC Ratio Sums greater than 1 will be considered as separate Areas of Concern because each of the Source Areas represents an area large enough to be considered a single residential exposure area (i.e., approximately 10 acres), and the Source Areas are separated by areas that have RBC Ratio Sums less than 1. The Great Western Reservoir (IHSS 200) Source Area is also considered an Area of Concern for the HHRA.

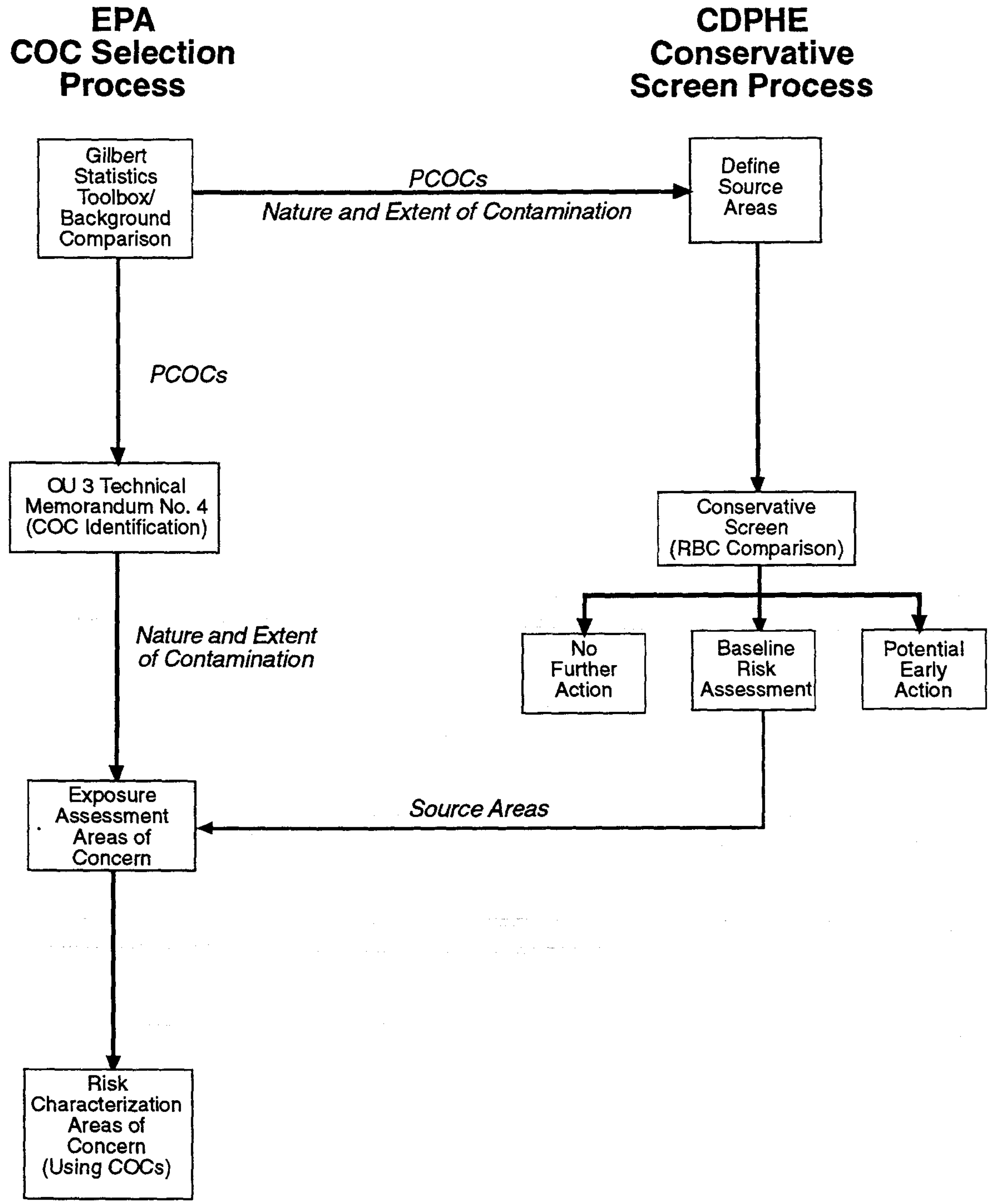
Section 1.0
INTRODUCTION

1.0 INTRODUCTION

The purpose of this report is to document the results of the Colorado Department of Public Health and Environment (CDPHE) Conservative Screen for Operable Unit No. 3 (OU 3), located adjacent to the Rocky Flats Environmental Technology Site (RFETS). The CDPHE Conservative Screen was used to identify "Source Areas" and "Areas of Concern" (i.e., one or several Source Areas grouped in close proximity) that will be addressed in the Human Health Risk Assessment (HHRA) portion of the Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) report for OU 3. OU 3 consists of the following Individual Hazardous Substances Sites (IHSSs):

- IHSS 199: Contamination of Soils
- IHSS 200: Great Western Reservoir
- IHSS 201: Standley Lake
- IHSS 202: Mower Reservoir.

The CDPHE Conservative Screen was developed as part of the Data Aggregation process used in HHRAs for RFETS by CDPHE, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE). The CDPHE Conservative Screen is used in conjunction with the chemicals of concern (COC) selection process (this process is discussed in Technical Memorandum No. 4, Human Health Risk Assessment, Chemicals of Concern Identification, Operable Unit 3, Rocky Flats Plant; DOE, 1994b), specified by EPA, to identify OU-specific COCs and the areas within the OUs that may be impacted by those chemicals (Figure 1-1). Results of the CDPHE Conservative Screen are used, in effect, to redefine the OU boundaries in terms of the area within the OU that exhibits chemical levels that exceed risk-based concentrations. Guidance for the Data Aggregation process was provided in a memorandum from DOE (DOE, 1994a) and at a presentation by CDPHE, EPA, and DOE on June 3, 1994 (CDPHE/EPA/DOE, 1994). (See Appendix A for copies of the memorandum and presentation materials.)



CDPHE = Colorado Department of Public Health and Environment

COC = Chemicals of Concern

EPA = U.S. Environmental Protection Agency

PCOC = Potential Chemical of Concern

Source: CDPHE/EPA/DOE, 1994

Figure 1-1
COC/AREA OF CONCERN IDENTIFICATION PROCESSES

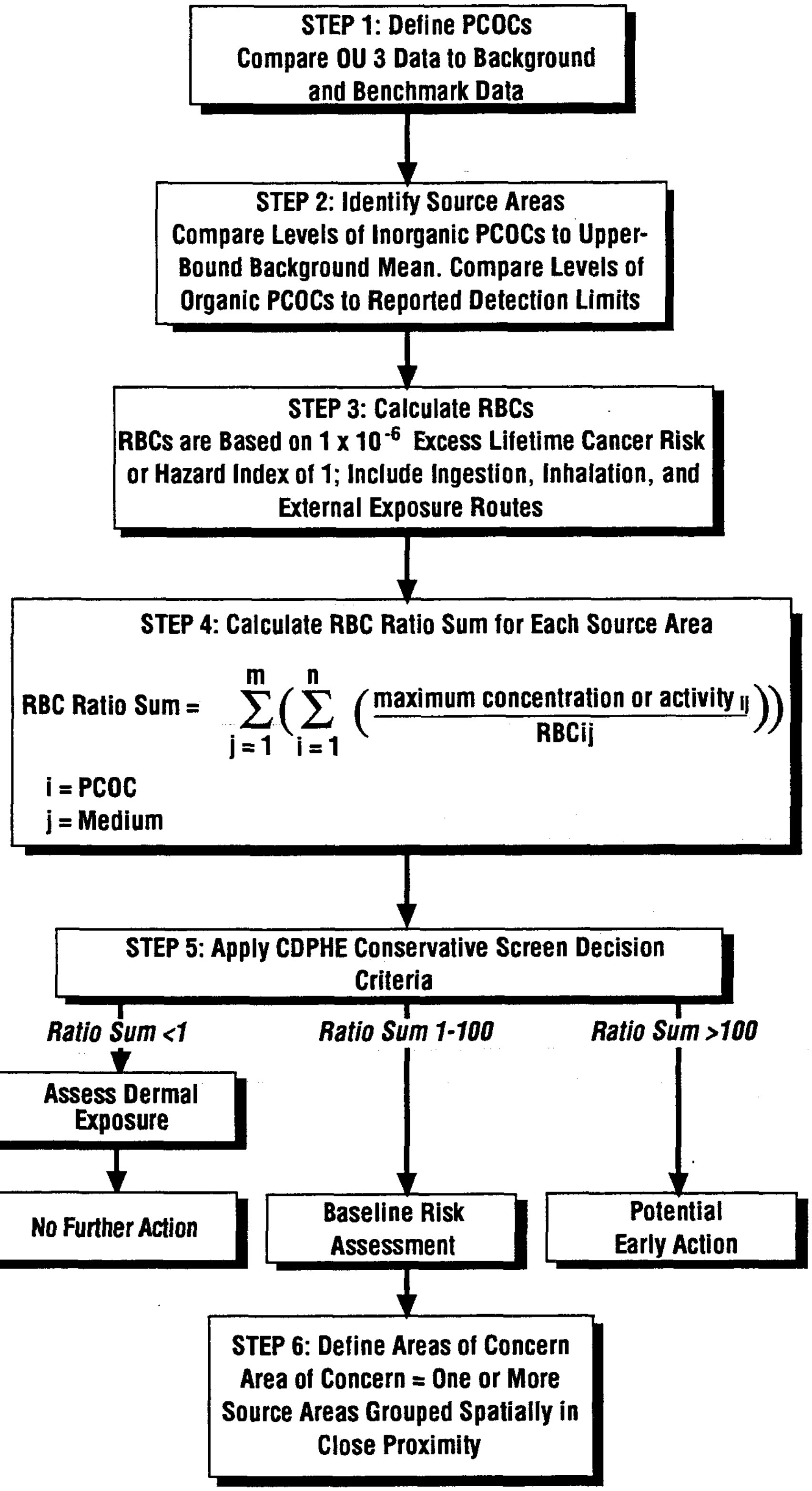
The CDPHE Conservative Screen Process (Figure 1-2) (CDPHE/EPA/DOE, 1994) includes the following steps:

- **Step 1 – Define Potential Chemicals of Concern (PCOCs)** – OU 3 data are compared to available background data, using statistical comparison tests, to identify PCOCs for each environmental medium. In addition, for OU 3, mean and maximum values for site data are compared to literature benchmark data and analyzed using various semi-quantitative methods. Environmental media for OU 3 include surface soil, sediment, surface water, and groundwater.

- **Step 2 – Identify Source Areas** – An Inorganic Source Area includes all sample locations in OU 3 where concentrations (nonradionuclides) or activities (radionuclides) of inorganic PCOCs are greater than upper-bound background values (i.e., background mean plus two standard deviations). An Organic Source Area includes all sample locations in OU 3 where concentrations of organic PCOCs are greater than reported detection limits.

- **Step 3 – Calculate a Risk-Based Concentration (RBC)** – The RBCs used in the CDPHE Conservative Screen for OU 3 are presented in Final Rocky Flats Programmatic Risk-Based Preliminary Remediation Goals (DOE, 1994c). The RBCs are based on a residential exposure scenario for soil, sediment, and groundwater.

- **Step 4 – Calculate RBC Ratio Sum for each Source Area** – Calculation of a RBC Ratio Sum involves three intermediate steps: (1) calculate ratio of maximum detected concentration or activity to RBC for each PCOC; (2) sum PCOC ratios for each medium; and (3) sum media ratios for each Source Area. RBC Ratio Sums are calculated for each Source Area to identify areas within OU 3 that may require further evaluation or action, based on RBC reference levels.



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

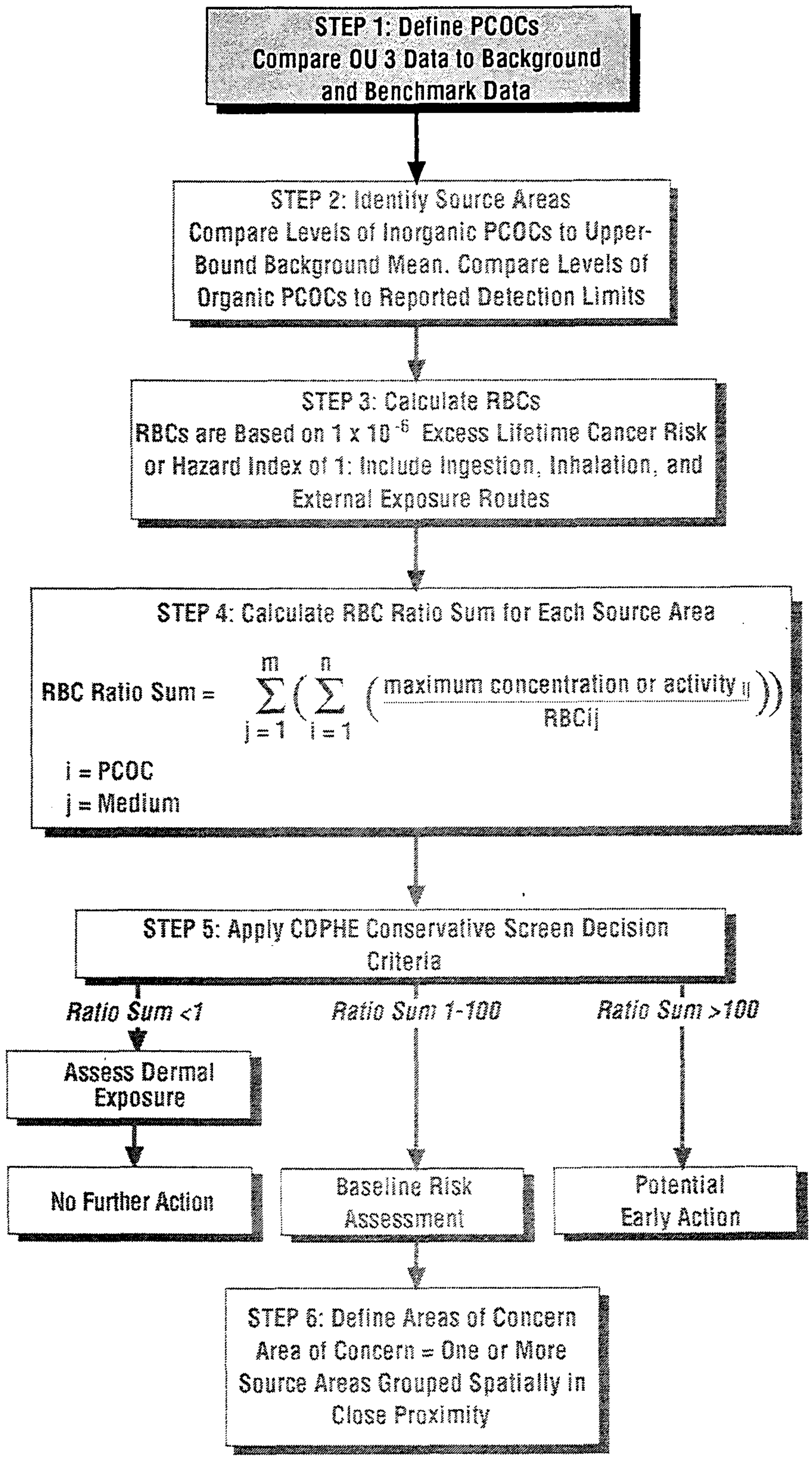
Figure 1-2
CDPHE CONSERVATIVE SCREEN PROCES
CDPHE LETTER REPORT

- **Step 5 – Apply CDPHE Conservative Screen Decision Criteria** – Identify the Source Areas that require no further action pending assessment of dermal exposure (i.e., Source Areas with Ratio Sums less than 1) and those that require further action. Source Areas with Ratio Sums between 1 and 100 require a baseline risk assessment; DOE may pursue voluntary corrective action for Source Areas with Ratio Sums greater than 100.

- **Step 6 – Define Area(s) of Concern** – An Area of Concern is an area within OU 3 that requires further evaluation, based on RBC reference levels. An Area of Concern consists of one or several Source Areas grouped spatially in close proximity.

The methodologies and results for each of these steps, as applied to each IHSS in OU 3, are described in the following sections of this report.

Section 2.0
STEP 1: POTENTIAL CHEMICAL OF CONCERN IDENTIFICATION



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

2.0 STEP 1: POTENTIAL CHEMICAL OF CONCERN IDENTIFICATION

The purpose of Step 1 is to identify PCOCs for OU 3. PCOCs are defined as inorganic analytes with concentrations or activities detected in OU 3 that are significantly elevated over background levels, and organic analytes detected in OU 3 at concentrations greater than the detection limits reported in the Rocky Flats Environmental Database System (RFEDS) data. The data selection procedures used to identify PCOCs are discussed in Subsection 2.1.

Step 1 of the CDPHE Conservative Screen corresponds to the "Statistical Comparison to Background" step of the EPA COC selection process for the HHRA. A brief description of this step is provided in Subsection 2.2 for each IHSS of OU 3. Results of the PCOC identification are then presented in Subsection 2.3. A detailed discussion of the methodologies, including the selection of data used in the CDPHE Conservative Screen, statistical methods, and interpretation of results, is available in Technical Memorandum No. 4, Human Health Risk Assessment, Chemicals of Concern Identification, Operable Unit 3, Rocky Flats Plant (TM 4) (DOE, 1994b).

2.1 DATA SETS EVALUATED IN THE CDPHE CONSERVATIVE SCREEN

Data collected during the OU 3 RFI/RI field investigation program were prepared for quantitative data analysis tasks, including the CDPHE Conservative Screen, following standard data-treatment protocols. A detailed description of the preparation process is included in Section 2.0 and Appendix A of TM 4. In addition, surface soil data from the Jefferson County Remedy Acres (DOE, 1991a) and sediment data from the 1983/84 Sediment Investigations in Great Western Reservoir (IHSS 200) and Standley Lake (IHSS 201) (DOE, 1991b) were used in the CDPHE Conservative Screen.

The OU 3 sample data sets are summarized in Table 2-1 by IHSS and medium, and the data sets used in the CDPHE Conservative Screen are identified. PCOCs will be identified for each IHSS and medium indicated in Table 2-1 and will be analyzed separately using the CDPHE Conservative Screen process.

TABLE 2-1

OU 3 DATA SETS
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

IHSS	Medium	Description	Used in CDPHE Screen?
199	Surface Soil	61 RFI/RI plots, average of CDPHE (0 - 0.25") and RFP (0 - 2") sample collection methods; 47 Jefferson County Remedy Acres locations	YES
	Subsurface Soil	11 trenches were sampled at 10 depth intervals down to 96 cm	NO
200	Surface Water	13 sample locations in reservoir and streams/ditches	YES
	Surface Sediment	41 RFI/RI sample locations in reservoir and streams/ditches sampled from 0 to 6"; 51 1983/84 sample locations	YES
	Subsurface Sediments	8 sample locations in reservoir sampled at 1" and 2" depth intervals down to approximately 36"	YES
	Ground Water	1 sample location	YES
201	Surface Water	12 sample locations in reservoir and streams/ditches	YES
	Surface Sediment	48 sample locations in reservoir and streams/ditches sampled from 0 to 6"; 63 1983/84 sample locations	YES
	Subsurface Sediments	8 sample locations in reservoir sampled at 1" and 2" depth intervals down to approximately 36"	NO*
	Ground Water	1 sample location	YES
202	Surface Water	8 sample locations in reservoir and streams/ditches	YES
	Surface Sediment	14 sample locations in reservoir and streams/ditches sampled from 0 to 6"	YES
	Subsurface Sediments	4 sample locations in reservoir sampled at 1" and 2" depth intervals down to approximately 36"	NO*

Note: * = Incomplete exposure pathway

The following media were evaluated in the CDPHE Conservative Screen for OU 3 (Table 2-1):

- Surface soil
- Surface sediments (0 to 6 inches) in reservoirs and streams/drainages
- Subsurface sediments (0 to 36 inches) in Great Western Reservoir (IHSS 200)
- Surface water in reservoirs and streams/drainages
- Groundwater.

The subsurface soil trench data were not used in the CDPHE Conservative Screen because the samples were primarily collected to characterize mobility of radionuclides in subsurface soil in support of the RI and other studies being conducted at RFETS. In addition, these were biased samples collected from a limited area of OU 3 and are not representative of the entire OU.

Because of the uncertainty regarding future use of Great Western Reservoir (IHSS 200), subsurface sediment data for IHSS 200 were included in the CDPHE Conservative Screen. The possibility exists that the reservoir could be drained. If Great Western Reservoir was drained, the potential exists for the construction of buildings or other facilities, and a receptor could be exposed to subsurface sediments at any depth interval as if the sediments were subsurface soil.

Subsurface sediments in Standley Lake (IHSS 201) and Mower Reservoir (IHSS 202) were not evaluated because it is unlikely either of these reservoirs will be drained in the future and, therefore, construction workers will not be exposed to subsurface sediments. Standley Lake is currently a source of drinking water and irrigation water; Mower Reservoir is privately owned and is used for agricultural purposes such as irrigation and water for livestock. No changes in use for either Standley Lake or Mower Reservoir are projected (DOE, 1993a).

Summary statistics (number of samples, detection frequency, minimum and maximum values, arithmetic mean, geometric mean, standard deviation, 95-percent upper confidence limit [UCL], and lognormal 95-percent UCL) for sediments, surface water, and groundwater analytes are provided in Appendix B (surface soil statistics are provided in TM4).

2.2 METHODOLOGIES FOR STEP 1

2.2.1 IHSS 199: Surface Soil

PCOCs for surface soil in OU 3 were identified using a statistical methodology for OU-to-background comparisons (agreed upon by EPA, CDPHE, and DOE) that is based on site-specific guidance developed by Gilbert (1993). This methodology is outlined in Figure 2-1 and includes a data-presentation step and a series of statistical comparison tests that are performed for each analyte.

The statistical methodology includes the following tests:

- Hot-Measurement test–each OU 3 measurement is compared to a "hot measurement" value (i.e., upper tolerance limit calculated from the background data)

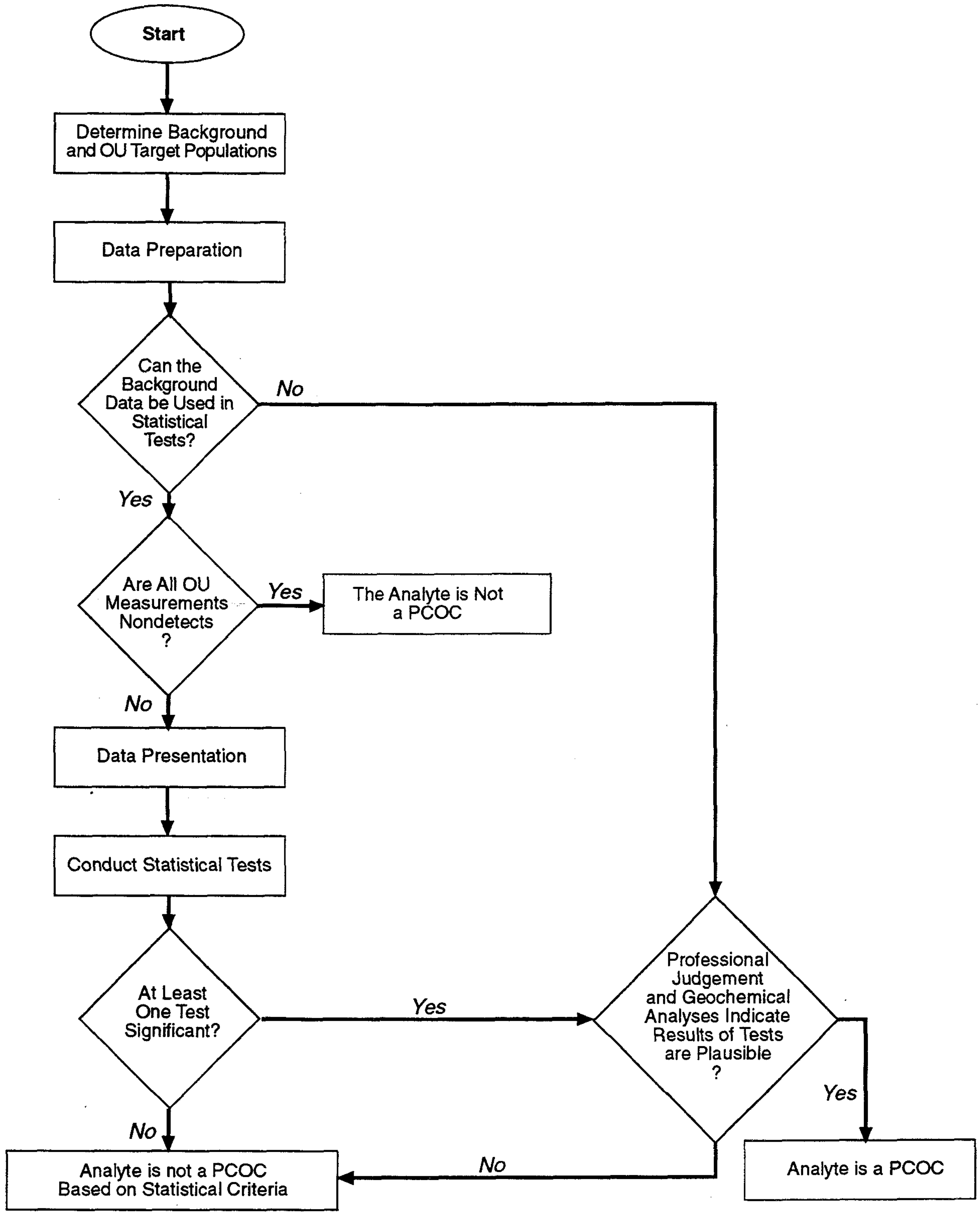
- Gehan test–used to determine if the medians of the two data sets are significantly different

- Quantile test–used to determine if the 80th percentiles of the two data sets are significantly different

- Slippage test–used to determine the number of OU 3 measurements that exceed the maximum background value

- t-test–used to determine if the means of the two data sets are significantly different.

The results of the statistical tests were used to determine if levels of chemicals in OU 3 are significantly elevated above background levels.



CDPHE = Colorado Department of Public Health and Environment

OU = Operable Unit

PCOC = Potential Chemical of Concern

Figure 2-1
FLOWCHART FOR COMPARING OU 3 DATA TO BACKGROUND CDPHE LETTER REPORT

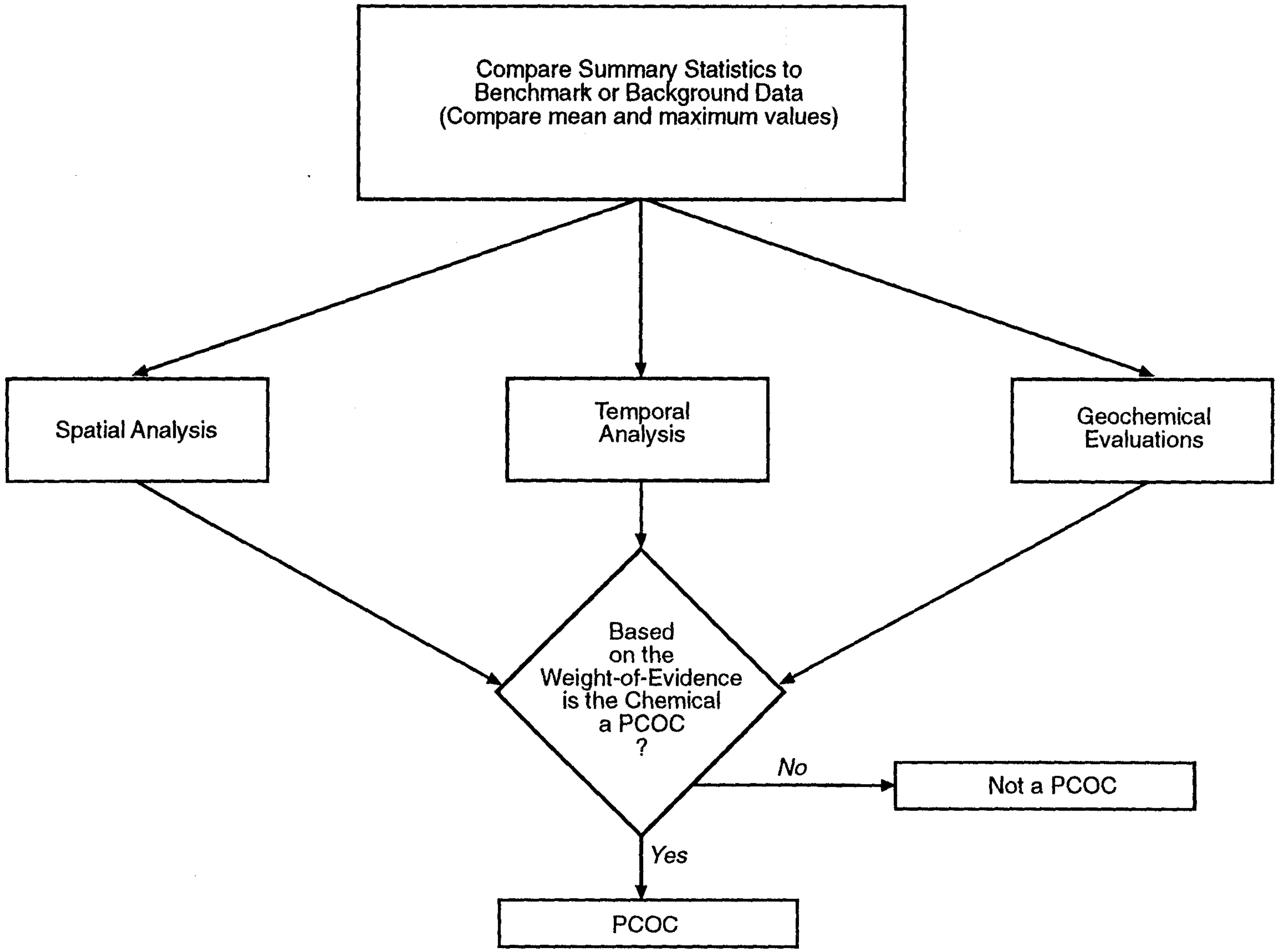
OU 3 surface soil data, including RFI/RI and Jefferson County Remedy Acres data (DOE, 1991a), and background data from the Rock Creek Area (DOE, 1993b) were used for Step 1 in the CDPHE Conservative Screen. Surface-soil samples were analyzed for radionuclides only (^{241}Am, $^{239/240}$Pu, $^{233/234}$U, ^{235}U, and ^{238}U).

2.2.2 IHSSs 200, 201, 202: Sediment, Surface Water, and Groundwater

After evaluating the OU 3 (IHSSs 200, 201, and 202) and background data sets for sediment, surface water, and groundwater (i.e., background data in the Background Geochemical Characterization Report [BGCR] [DOE, 1993c]), it was determined that the OU 3 and background data sets are not comparable for the purpose of rigorous statistical comparisons because the data sets represent different environmental conditions and flow regimes (e.g., OU 3 surface-water data are predominantly for reservoirs and the background surface-water data are for streams) (see TM 4 for details).

Literature benchmark data sets for sediment, surface water, and groundwater also were not considered appropriate for rigorous quantitative statistical comparisons because of small sample size and limited information about data quality.

Because the statistical background comparison methodology was not considered appropriate for sediment, surface water, and groundwater in IHSSs 200 through 202, an alternative approach for selecting PCOCs was used for these media (EPA, 1994a). The alternative approach is referred to as the "weight-of-evidence evaluation" because it relies on a series of data analyses (Figure 2-2).



PCOC = Potential Chemical of Concern

Figure 2-2
WEIGHT-OF-EVIDENCE EVALUATIONS
CDPHE LETTER REPORT

The results of the analyses are considered together to assess whether levels of chemicals detected in OU 3 represent background conditions or contamination. The following analyses are included in the weight-of-evidence evaluation:

- Comparison of means, standard deviations, and ranges of OU 3 data to BGCR data (DOE, 1993c)

- Comparisons of means, standard deviations, and ranges of OU 3 data to literature benchmark data (comparisons to benchmark data were made using data presented in summary tables in Appendix B)

- Temporal analysis of data to identify seasonal variations or sampling anomalies

- Spatial analysis combined with the evaluation of physical processes affecting deposition and the evaluation of contribution of various water sources to OU 3 reservoirs
- Probability plot analyses to evaluate data populations (using PROBPLOT software)

In addition, a comparison was made to the Phase 1 Health Studies Materials of Concern (CDPHE, 1991a; CDPHE, 1991b; CDPHE, 1992) to confirm the identification or elimination of a chemical as a PCOC (See TM4, Section 3.10).

The data sets used in Step 1 for IHSSs 200 through 202 include the following:

- RFI/RI groundwater data (total metals, total radionuclides)

- RFI/RI sediment data (radionuclides, metals, cyanide, volatile organic compounds [VOCs] in IHSS 202 only)

- RFI/RI surface-water data (total metals, total radionuclides, VOCs in IHSS 202 only)

- 1983/84 Sediment Investigations data ($^{239/240}$Pu in IHSS 200 and 201) (DOE, 1991b)

- Sediment, surface-water, and groundwater data from the BGCR (DOE, 1993c)

- Background data for sediments from Lowry Landfill Superfund Site (EPA, 1992a)

- Literature benchmark data for sediments from Rocky Mountain National Park lakes (Heit, et al., 1984) and Cherry Creek Reservoir (CCBA, 1994)

- Literature benchmark data for surface water from Colorado Front Range streams and lakes obtained from Arvada Department of Water and Environmental Quality (Arvada, 1994) and EPA's STORET database (EPA, 1993; EPA, 1994b)

- Literature benchmark data for groundwater (Dragun, 1988; Mathess, 1982).

An example of the weight-of-evidence evaluation for arsenic in sediments is presented in Subsection 3.9 of TM 4 and is provided in Appendix C of this document. This example explains each analysis, including PROBPLOT, used in the weight-of-evidence evaluations.

2.3 RESULTS

Table 2-2 lists PCOCs by medium and IHSS for OU 3 based on the methodologies described above. Brief discussions of the results presented in Table 2-2 are provided in the following subsections. Detailed discussions of the results of the statistical comparison tests for surface soil and the weight-of-evidence evaluations for sediment, surface water, and groundwater are provided in TM 4.

TABLE 2-2

OU 3 POTENTIAL CHEMICALS OF CONCERN
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Media	IHSS	PCOCs
Surface Soil	199	^{241}Am
		$^{239/240}Pu$
Surface Sediment (Grab Samples)	200 (Great Western Reservoir)	$^{239/240}Pu$
	201 (Standley Lake)	None
	202 (Mower Reservoir)	None
Subsurface Sediments (Core Samples)	200 (Great Western Reservoir)	$^{239/240}Pu$
		Copper
Surface Water	200 (Great Western Reservoir)	None
	201 (Standley Lake)	None
	202 (Mower Reservoir)	None
Groundwater	200 (Great Western Reservoir)	Strontium
	201 (Standley Lake)	None

Note: Potential chemicals of concern (PCOCs) are inorganic chemicals with detected concentrations above background levels or organic chemicals detected above reported detection limits.

2.3.1 Surface Soil

The results of the background statistical comparison indicate ^{241}Am and $^{239/240}$Pu are PCOCs for surface soil in OU 3. These two radionuclides were identified as PCOCs by more than one statistical test (i.e., Hot-Measurement test, Slippage test, Quantile test, and Gehan test for ^{241}Am and $^{239/240}$Pu, and t-test for $^{239/240}$Pu), and the pattern of ^{241}Am and $^{239/240}$Pu activities in surface soil suggest that the reported levels are not attributable to background conditions. Uranium^{235} was not identified as a PCOC by any of the statistical tests. One statistical test (Hot-Measurement test) indicated $^{233/234}$U and ^{238}U may be PCOCs; however, after further spatial analysis of the pattern of activities for these two radionuclides, the observed distribution of activities was attributed to natural variation and was not indicative of contamination. Therefore, $^{233/234}$U and ^{238}U were not retained as PCOCs. TM 4 (Section 4.3) contains a detailed discussion of this spatial analysis.

2.3.2 Surface Sediments

Weight-of-evidence evaluations were performed for radionuclides, metals, and organic (IHSS 202 only) compounds in surface sediments. Results of these evaluations are summarized in the following subsections. Table 2-3 summarizes the results of the weight-of-evidence evaluations for all inorganic analytes in surface sediments. Columns 3 and 4 in Table 2-3 show comparisons of OU 3 data to BGCR stream-sediment data and benchmark data for lakes, respectively; mean and maximum values for the corresponding data sets were compared. Column 5 indicates if a spatial analysis of the chemical distribution suggests natural deposition or whether a trend indicates contamination. Column 6 reports whether a PROBPLOT analysis was performed; PROBPLOT is used to assess if more than one population is included within a data set. Details of PROBPLOT and the results for OU 3 are provided in TM 4. Column 7 contains comments, and Column 8 indicates if the chemical is carried through the CDPHE Conservative Screen (i.e., is identified as a PCOC).

TABLE 2-3

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 SURFACE SEDIMENTS (GRAB SAMPLES)
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6	7	8
IHSS	**Chemical**	**Background Stream Evaluation**	**Benchmark Reservoir Evaluation**	**Spatial Trend?**	**PROBPLOT Analysis?**	**Comments**	**PCOC?**
200	^{241}Am	<MEAN,<MAX	NA	No Trend	NO		NO
201	^{241}Am	<MEAN,<MAX	NA	No Trend	NO		NO
202	^{241}Am	<MEAN,<MAX	NA	No Trend	NO		NO
200	Aluminum	<MEAN,<MAX	NA,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to BGCR and Lowry Landfill data, indicative of normal background population.	NO
201	Aluminum	<MEAN,>MAX	NA,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to BGCR and Lowry Landfill data, indicative of normal background population.	NO
202	Aluminum	<MEAN,<MAX	NA,<MAX	No Trend	YES	PROBPLOT: Two populations. Natural variability due to precipitation occurring with varying pH.	NO
200	Antimony	<MEAN,<MAX	NA	No Trend	NO		NO
201	Antimony	<MEAN,<MAX	NA	No Trend	NO		NO
202	Antimony	<MEAN,<MAX	NA	No Trend	NO		NO
200	Arsenic	<MEAN+2SD,<MAX	<MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Arsenic	<MEAN,<MAX	<MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Contribution of highly mineralized sediments from Clear Creek. Mean and maximum similar to benchmark data.	NO
202	Arsenic	<MEAN+2SD,<MAX	<MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to benchmark data, indicative of normal background population.	NO
200	Barium	<MEAN,<MAX	NA,<MAX	No Trend	NO		NO
201	Barium	<MEAN,<MAX	NA,<MAX	No Trend	NO		NO
202	Barium	<MEAN,<MAX	NA,<MAX	No Trend	NO		NO
200	Beryllium	<MEAN,<MAX	<MEAN,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Beryllium	<MEAN,<MAX	<MEAN,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Beryllium	<MEAN,<MAX	<MEAN,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	Cadmium	<MEAN,<MAX	>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Cadmium	<MEAN+2SD,>MAX	>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Cadmium	ND	ND	ND	NO	ND	NO
200	Calcium	<MEAN+2SD,>MAX	>MEAN	No Trend	NO		NO
201	Calcium	>MEAN+2SD,>MAX	>MEAN	No Trend	NO		NO
202	Calcium	>MEAN+2SD,>MAX	>MEAN	No Trend	NO		NO
200	Cesium	ND	NA	ND	NO	ND	NO
201	Cesium	<MEAN,<MAX	NA	No Trend	NO		NO
202	Cesium	<MEAN,<MAX	NA	No Trend	NO		NO
200	^{137}Cs	<MEAN,<MAX	NA	No Trend	NO		NO
201	^{137}Cs	N/A	ND	ND	NO		NO
202	^{137}Cs	N/A	N/A	No Trend	NO		NO

TABLE 2-3

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 SURFACE SEDIMENTS (GRAB SAMPLES)
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 Background Stream Evaluation	4 Benchmark Reservoir Evaluation	5 Spatial Trend?	6 PROBPLOT Analysis?	7 Comments	8 PCOC?
200	Chromium	<MEAN,<MAX	NA	No Trend	YES	PROBPLOT: Two populations. Small slopes for both populations due to adsorption or precipitation, organic adsorption, or algal bioaccumulation.	NO
201	Chromium	<MEAN,>MAX	NA	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Chromium	<MEAN+2SD,<MAX	NA	No Trend	YES	PROBPLOT: Two populations. Small slopes for both populations due to adsorption or precipitation, organic adsorption, or algal bioaccumulation. Algal blooms and varying pHs were observed at Mower.	NO
200	Cobalt	<MEAN+2SD,>MAX	NA,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Cobalt	<MEAN,<MAX	NA,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Cobalt	<MEAN,<MAX	NA,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	Copper	<MEAN+2SD,<MAX	NA,>MAX	No Trend	NO		NO
201	Copper	<MEAN+2SD,>MAX	NA,>MAX	No Trend	NO		NO
202	Copper	<MEAN,<MAX	NA,>MAX	No Trend	NO		NO
200	Cyanide	ND	ND	ND	NO	Not Detected	NO
201	Cyanide	ND	ND	ND	NO	Not Detected	NO
202	Cyanide	ND	ND	ND	NO	Not Detected	NO
200	Iron	>MEAN+2SD,>MAX	>MEAN,>MAX	No Trend	YES	PROBPLOT: One population. High iron concentrations typical for sediments from lacustrine environments. Means and medians for the three reservoirs are nearly the same.	NO
201	Iron	<MEAN+2SD,<MAX	>MEAN,<MAX	No Trend	YES	PROBPLOT: One population. High iron concentrations typical for sediments from lacustrine environments. Means and medians for the three reservoirs are nearly the same.	NO
202	Iron	<MEAN+2SD,<MAX	>MEAN,<MAX	No Trend	YES	PROBPLOT: One population. High iron concentrations typical for sediments from lacustrine environments. Means and medians for the three reservoirs are nearly the same.	NO
200	Lead	<MEAN,<MAX	<MEAN,>MAX	No Trend	YES	PROBPLOT: One population. One sample exceeds 95 percentile concentration. Sample is located in deep portion of reservoir, rich in organic and fine grained material containing complex and adsorbed metals.	NO
201	Lead	<MEAN+2SD,<MAX	>MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Maximum concentration likely due to contribution from highly mineralized Clear Creek sediments.	NO
202	Lead	<MEAN,<MAX	<MEAN,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	Lithium	<MEAN+2SD,<MAX	NA	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Lithium	<MEAN+2SD,>MAX	NA	No Trend	YES	PROBPLOT: One population. Maximum concentration likely due to the fact that lithium is a common constituent in micas, which are released by acid attack, a phenomenon that happens in mine waste areas such as Clear Creek, a source feeding IHSS 201.	NO
202	Lithium	<MEAN+2SD,<MAX	NA	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	Magnesium	<MEAN+2SD,<MAX	NA	No Trend	NO		NO
201	Magnesium	<MEAN+2SD,>MAX	NA	No Trend	NO		NO
202	Magnesium	<MEAN+2SD,<MAX	NA	No Trend	NO		NO
200	Manganese	<MEAN+2SD,<MAX	NA,>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO

TABLE 2-3

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 SURFACE SEDIMENTS (GRAB SAMPLES)
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 Background Stream Evaluation	4 Benchmark Reservoir Evaluation	5 Spatial Trend?	6 PROBPLOT Analysis?	7 Comments	8 PCOC?
201	Manganese	>MEAN+2SD,>MAX	NA,>MAX	No Trend	YES	PROBPLOT: One population. High manganese concentrations probably reflect contribution from the highly mineralized Clear Creek sediments to Standley Lake.	NO
202	Manganese	<MEAN,<MAX	NA,>MAX	No Trend	YES	PROBPLOT: Two populations. Second population has a slope parallel to the lower population indicating a similar process forming both populations and the higher concentrations indicate an asymptotic character typical of the precipitation process.	NO
200	Mercury	ND	<MEAN,>MAX	No Trend	NO		NO
201	Mercury	<MEAN,<MAX	>MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Mercury	ND	>MEAN,>MAX	No Trend	NO	Means VERY similar to lake background. Insufficient number of detects to perform PROBPLOT.	NO
200	Molybdenum	<MEAN+2SD,>MAX	NA,<MAX	No Trend	NO		NO
201	Molybdenum	<MEAN,<MAX	NA,<MAX	No Trend	NO		NO
202	Molybdenum	ND	ND	ND	NO		NO
200	Nickel	<MEAN+2SD,<MAX	<MEAN,<MAX	No Trend	YES	One sample exceeds 95th percentile concentration. This is the same location that has the highest conc. of Co, Mn and Fe. This is the result of Fe/Mn oxyhydroxide adsorption which elevates the Ni and Co concentrations through the adsorption process.	NO
201	Nickel	<MEAN,<MAX	<MEAN,<MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	Nickel	<MEAN,<MAX	<MEAN,>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	Potassium	<MEAN+2SD,<MAX	NA,<MAX	No Trend	NO		NO
201	Potassium	<MEAN+2SD,>MAX	NA,<MAX	No Trend	NO		NO
202	Potassium	<MEAN+2SD,<MAX	NA,<MAX	No Trend	NO		NO
200	^{238}Pu	N/A	N/A	N/A	NO		NO
201	^{238}Pu	N/A	N/A	N/A	NO		NO
202	^{238}Pu	N/A	N/A	N/A	NO		NO
200	$^{239/240}Pu$	<MEAN,<MAX	>MAX	No Trend	YES	PROBPLOT: One population. Mean similar to background and benchmark data, indicative of normal background population.	YES
201	$^{239/240}Pu$	<MEAN,<MAX	>MAX	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	$^{239/240}Pu$	<MEAN, <MAX	>MAX	No Trend	YES	PROBPLOT: One population.	NO
200	^{226}Ra	<MEAN+2SD,<MAX	NA	No Trend	YES	One sample exceeds the 95th percentile value for background population. This sample is the same sample that exceeds 95th perc. for $^{233/234}U$, ^{235}U, and ^{238}U, suggesting natural uranium mineralization from the drainages rather than anthropogenic contam.	NO
201	^{226}Ra	N/A	NA	N/A	YES	Insufficient detections to represent a statistically definable population.	NO
202	^{226}Ra	N/A	N/A	N/A	YES	Insufficient detections to represent a statistically definable population.	NO
200	^{228}Ra	N/A	NA	No Trend	NO		NO
201	^{228}Ra	N/A	NA	N/A	NO		NO
202	^{228}Ra	N/A	N/A	N/A	NO		NO
200	Selenium	<MEAN+2SD,<MAX	<MEAN,>MAX	No Trend	NO		NO
201	Selenium	<MEAN+2SD,<MAX	<MEAN,>MAX	No Trend	NO		NO
202	Selenium	ND	<MEAN,>MAX	No Trend	NO		NO

TABLE 2-3

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 SURFACE SEDIMENTS (GRAB SAMPLES)
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6	7	8
IHSS	Chemical	Background Stream Evaluation	Benchmark Reservoir Evaluation	Spatial Trend?	PROBPLOT Analysis?	Comments	PCOC?
200	Silicon	<MEAN+2SD,<MAX	NA	No Trend	YES	PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	Silicon	>MEAN+2SD,>MAX	NA	No Trend	YES	Max concentration less than 1% to an average crustal abundance of approx. 27%. Sediments in IHSS 201 have higher quartz content relative to mica content in each reservoir. Quartz is also readily available in mine waste near Clear Creek drainage.	NO
202	Silicon	<MEAN+2SD,<MAX	NA	No Trend	NO	Insufficient data to perform PROBPLOT	NO
200	Silver	<MEAN+2SD,>MAX	NA,>MAX	No Trend	NO		NO
201	Silver	<MEAN,<MAX	NA,>MAX	No Trend	NO		NO
202	Silver	<MEAN,<MAX	NA,>MAX	No Trend	NO		NO
200	Sodium	>MEAN+2SD,>MAX	NA	No Trend	NO		NO
201	Sodium	<MEAN+2SD,>MAX	NA	No Trend	NO		NO
202	Sodium	<MEAN+2SD,<MAX	NA	No Trend	NO		NO
200	$^{89/90}Sr$	<MEAN+2SD,<MAX	NA	No Trend	NO	Creek: n=6, 0.01 off of background	NO
201	$^{89/90}Sr$	N/A	NA	N/A	NO		NO
202	$^{89/90}Sr$	N/A	N/A	N/A	NO		NO
200	Strontium	<MEAN+2SD,<MAX	NA,<MAX	No Trend	NO		NO
201	Strontium	<MEAN+2SD,<MAX	NA,>MAX	No Trend	NO		NO
202	Strontium	<MEAN+2SD,<MAX	NA,<MAX	No Trend	NO		NO
200	Thallium	ND	NA	ND	NO	Not Detected	NO
201	Thallium	<MEAN,<MAX	NA	No Trend	NO		NO
202	Thallium	<MEAN,<MAX	NA	No Trend	NO		NO
200	Tin	ND	NA	ND	NO	Not Detected	NO
201	Tin	ND	NA	ND	NO	Not Detected	NO
202	Tin	ND	NA	ND	NO	Not Detected	NO
200	Tritium	<MEAN+2SD,<MAX	NA	No Trend	NO	Creek: N=4, Detection Frequency = 50%	NO
201	Tritium	<MEAN,<MAX	N/A	No Trend	NO		NO
202	Tritium	N/A	N/A	N/A	NO		NO
201	$^{233/234}U$	<MEAN,<MAX	<MAX	No Trend	YES	Reservoir: Total Uranium only. PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
202	$^{233/234}U$	<MEAN,>MAX	<MAX	No Trend	YES	Reservoir: Total Uranium only. PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
200	$^{233/234}U$	<MEAN,<MAX	<MAX	No Trend	YES	Reservoir: Total Uranium only. PROBPLOT: One population. Mean and Max similar to background and benchmark data, indicative of normal background population.	NO
201	^{235}U	<MEAN+2SD,>MAX	<MAX	No Trend	YES	Creek: BKGND MEAN & MAX > ONSITE MEAN & MAX BY 0.01, Reservoir: Total U only. PROBPLOT: One sample exceeds 95th percentile conc. This sample may represent a natural uranium mineralization from the drainages adjacent to the pediment.	NO
202	^{235}U	<MEAN+2SD,>MAX	<MAX	No Trend	YES	Creek: BKGND MAX > ONSITE MAX BY 0.01, Reservoir: Total Uranium only. Mean and maximum similar to benchmark data, indicative of normal background population.	NO
200	^{235}U	<MEAN+2SD,<MAX	<MAX	No Trend	YES	Reservoir: Total Uranium only. Mean and maximum similar to benchmark data, indicative of normal background population.	NO
200	^{238}U	=MEAN,<MAX	<MEAN	No Trend	NO	Reservoir: Total Uranium only	NO

TABLE 2-3

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 SURFACE SEDIMENTS (GRAB SAMPLES)
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6	7	8
IHSS	Chemical	Background Stream Evaluation	Benchmark Reservoir Evaluation	Spatial Trend?	PROBPLOT Analysis?	Comments	PCOC?
201	^{238}U	<MEAN,>MAX	<MEAN	No Trend	NO	Reservoir: Total Uranium only	NO
202	^{238}U	<MEAN,<MAX	<MEAN	No Trend	NO	Creek: BKGND MAX > ONSITE MAX BY 0.08, Reservoir: Total Uranium only	NO
200	Vanadium	<MEAN+2SD,>MAX	<MEAN,<MAX	No Trend	NO		NO
201	Vanadium	<MEAN,<MAX	<MEAN,<MAX	No Trend	NO		NO
202	Vanadium	<MEAN+2SD,<MAX	<MEAN,<MAX	No Trend	NO		NO
200	Zinc	<MEAN+2SD,<MAX	>MEAN+2SD,>MAX	No Trend	YES	PROBPLOT: One population. Sediment concentrations indicate overall influence of historical mining wastes and not anthropogenic contamination on the sediments.	NO
201	Zinc	>MEAN+2SD,>MAX	>MEAN+2SD,>MAX	No Trend	YES	PROBPLOT: One population. Sediment concentrations indicate overall influence of historical mining wastes and not anthropogenic contamination on the sediments.	NO
202	Zinc	<MEAN,<MAX	<MEAN+2SD,>MAX	No Trend	YES	PROBPLOT: One population. Sediment concentrations indicate overall influence of historical mining wastes and not anthropogenic contamination on the sediments.	NO

Notes:
IHSS - Individual Hazardous Substance Site.
ND = Not detected.
N/A = Not analyzed in OU 3.
NA = Benchmark data not available.
*Chemical is an essential nutrient.
<Mean = OU 3 mean value is less than background or benchmark mean value.
>Mean = OU 3 mean value is greater than background or benchmark mean value.
<Max = OU 3 maximum value is less than background or benchmark near value.
>Max = OU 3 maximum value is greater than background or benchmark maximum value
MAX = maximum value.
MEAN + 2SD = upper bound background mean (i.e., mean plus two standard deviations).

Column 1: IHSS 200: Great Western Reservoir; IHSS 201: Standley Lake; IHSS 202: Mower Reservoir.
Column 3: Comparison of OU 3 stream to Background Geochemical Characterization Report stream sediments data and Lowry Landfill Background stream sediments data.
Column 4: Comparison of OU 3 reservoir to benchmark literature lake data.
Column 5: No Trend = spatial analyses indicates no contamination from RFP. Spatial distribution is consistent with physical properties associated with natural deposition.
Column 6: Yes = chemical was analyzed using PROBPLOT, No = not analyzed using PROBPLOT.
Column 7: Discussion of weight-of-evidence results.
Column 8: Yes = identified as a potential chemical of concern (PCOC), No = not a PCOC.

2.3.2.1 Radionuclides

The results of the weight-of-evidence evaluations for Great Western Reservoir (IHSS 200) indicate $^{239/240}$Pu is the only PCOC for surface sediments, based on the following:

- For IHSS 200, the mean and maximum values for $^{239/240}$Pu in reservoir-sediment samples exceed corresponding mean and maximum benchmark values.

- The maximum value for IHSS 200 stream-sediment samples exceeds the maximum BGCR stream-sediment value.

Plutonium$^{239/240}$ is not retained as a PCOC for IHSSs 201 and 202 for the following reasons:

- For IHSS 201, the mean value of $^{239/240}$Pu in OU 3 reservoir-sediment samples was less than the benchmark values, and the mean and maximum values for OU 3 stream-sediment samples were less than corresponding mean and maximum BGCR stream-sediment values. In addition, the PROBPLOT analysis indicates the data set consists of only one population.

- For IHSS 202, the mean and maximum values for $^{239/240}$Pu in OU 3 stream-sediment samples are less than corresponding mean and maximum BGCR stream-sediment values. In addition, the PROBPLOT analysis for IHSS 202 indicates the $^{239/240}$Pu data set consists of only one population.

2.3.2.2 Metals

In general, mean and maximum OU 3 metal concentrations are less than background and benchmark values. Calcium and sodium concentrations are an exception. Also, for most metals, PROBPLOT identified only one population. Table 2-3 provides the detail information for each metal.

The comparisons of OU 3 data to benchmark values indicate that mean concentrations of calcium in reservoir-sediment samples for IHSSs 200, 201, and 202 exceed benchmark upper bound mean values (i.e., mean plus two standard deviations). In IHSSs 200 and 201, maximum values of sodium in stream-sediment samples exceed maximum BGCR values; benchmark data for reservoirs were not available for comparison. Although both calcium and sodium have OU 3 concentrations exceeding background and benchmark data, they were not retained as PCOCs for the remaining steps of the CDPHE Conservative Screen because they are both considered to be essential human nutrients and are not evaluated for risk (EPA, 1989a). TM 4 includes a discussion of the elimination of five essential nutrients as COCs.

2.3.2.3 Organic Compounds

Six organic compounds were detected in sediment samples from IHSS 202 (Mower Reservoir): 2-butanone, acetone, methylene chloride, total xylenes, toluene, and trichlorotrifluoroethane. No other organic compounds were detected in sediment samples. The detected organic compounds were not retained as PCOCs for the reasons given below.

- 2-Butanone–Three of 12 samples were detects; all 3 detects were J-qualified, indicating that reported concentration is estimated (i.e., reported concentration is less than the contract-required detection limit, but greater than the instrument detection limit). 2-butanone is a common laboratory contaminant (EPA, 1988); therefore, low levels detected in samples may be due to contamination at the laboratory. Maximum detected value is 14.0 micrograms per kilogram (µg/kg).

- Acetone–Six of 15 samples were detects; 5 of the 6 detects were J-qualified; 2 of the 6 detects were B-qualified, indicating blank contamination problems. Acetone is a common laboratory contaminant (EPA, 1988). Maximum detected value is 47.0 µg/kg.

- Methylene chloride–Three of 14 samples were detects; all detects were J-qualified. Methylene chloride is a common laboratory contaminant (EPA, 1988). Maximum detected value is 5.0 µg/kg.

- Total xylenes–One of 10 samples was a detect; the detect value was J-qualified. Maximum detected value is 2.0 µg/kg.

- Toluene–Three of 11 samples were detects; 2 of 3 detects were J-qualified. Toluene is a common laboratory contaminant (EPA, 1988). Maximum detected value is 16.0 µg/kg.

- Trichlorotrifluoroethane–Only one sample was analyzed for trichlorotrifluoroethane; the detected value was 50.0 µg/kg and was J- and B-qualified.

These six organic compounds detected in Mower Reservoir were not retained as PCOCs based on detection frequency, frequency of qualification (i.e., J-qualifier), low concentration levels, and the presence of some compounds in the corresponding blank samples (i.e., B-qualifier indicates "detects" represent contamination or laboratory artifacts). (Note: Laboratory blank data were not available to compare concentrations of organic compounds in the OU 3 samples to concentrations in the laboratory blanks.) This conclusion is supported by the Phase I Health Studies, which did not identify 2-butanone, acetone, total xylenes, toluene, or trichlorotrifluoroethane as materials of concern (CDPHE, 1992).

2.3.3 Subsurface Sediments

The results of the weight-of-evidence evaluations indicate $^{239/240}$Pu and copper are PCOCs for subsurface sediments in Great Western Reservoir (IHSS 200), based on the following:

- The mean and maximum copper concentrations exceed the BGCR mean and maximum values; the maximum copper concentration exceeds the maximum benchmark value.

- For IHSS 200, the mean and maximum values for $^{239/240}Pu$ in subsurface-sediment samples exceed corresponding mean and maximum benchmark values and BGCR stream-sediment values.

Table 2-4 summarizes the results of the weight-of-evidence evaluations for all analytes in Great Western Reservoir subsurface sediments. Columns 3 and 4 in Table 2-4 show comparisons of OU 3 data to background and benchmark data, respectively; mean and maximum values for the corresponding data sets were compared. Column 5 indicates if a spatial analysis was performed. Column 6 contains comments, and Column 7 indicates if the chemical is carried through the CDPHE Conservative Screen (i.e., is identified as a PCOC). No PROBPLOT analyses were performed for subsurface sediments.

2.3.4 Surface Water

No VOCs were detected in surface-water samples from IHSS 202 and, therefore, no organic PCOCs were identified for surface water. Based on the weight-of-evidence evaluations, no inorganic PCOCs were identified for surface water in IHSSs 200, 201, or 202. In general, OU 3 chemical mean and maximum values are less than corresponding background and benchmark values. Table 2-5 summarizes the results of the weight-of-evidence evaluations for all analytes in surface water. Columns 3 and 4 in Table 2-5 show comparisons of OU 3 data to background and benchmark data, respectively; mean and maximum values for the corresponding OU 3 and background/benchmark data sets were compared. Column 5 indicates if spatial analysis of the chemical distribution suggests natural deposition or contamination. Column 6 reports results of PROBPLOT analyses. Details of the PROBPLOT results for surface water are provided in TM 4. Column 7 contains comments, and Column 8 indicates if the chemical is carried through the CDPHE Conservative Screen (i.e., is identified as a PCOC).

2.3.5 Groundwater

The results of the weight-of-evidence evaluations indicate strontium is a PCOC for groundwater (IHSS 200 only) for the following reasons:

TABLE 2-4

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
GREAT WESTERN RESERVOIR IHSS 200--SUBSURFACE SEDIMENT CORES
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 Background-Creek and Lake Surface Sediments Evaluation	4 Benchmark Lake Subsurface Sediments Evaluation	5 Spatial Analysis Performed?	6 Comments	7 PCOC
200	^{241}Am	<MEAN+2SD,>MAX	NA	NO		NO
200	Aluminum	<MEAN,<MAX	NA	NO		NO
200	Arsenic	<MEAN,<MAX	>MEAN	NO		NO
200	Barium	<MEAN,<MAX	NA	NO		NO
200	Beryllium	<MEAN+ 2SD, <MAX	<MEAN	NO		NO
200	Cadmium	<MEAN,<MAX	>MEAN	NO		NO
200	Calcium	<MEAN+2SD,<MAX	>MEAN	NO		NO
200	Cesium	<MEAN,<MAX	NA	NO		NO
200	Chromium	<MEAN+2SD,<MAX	NA	NO		NO
200	Cobalt	<MEAN+2SD,<MAX	NA	NO		NO
200	Copper	>MEAN+2SD>MAX	NA	YES	Spatial Analysis: Highest concentrations observed at approximately 24-26 inches (SED08692 AND SED09192), corresponding to a time of deposition circa 1964 (Wolaver and Burger, 1994).	YES
200	Cyanide	ND	ND	NO		NO
200	Iron	<MEAN+2SD,<MAX	>MEAN	NO		NO
200	Lead	<MEAN+2SD,<MAX	>MEAN	NO		NO
200	Lithium	<MEAN+2SD,<MAX	NA	NO		NO
200	Magnesium	<MEAN+2SD,<MAX	NA	NO		NO
200	Manganese	<MEAN+2SD,<MAX	NA	NO		NO
200	Mercury	<MEAN+2SD,>MAX	>MEAN	NO		NO
200	Molybdenum	<MEAN,<MAX	NA	NO		NO
200	Nickel	<MEAN + 2SD,<MAX	>MEAN	NO		NO
200	Potassium	<MEAN+2SD,<MAX	NA	NO		NO

TABLE 2-4

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
GREAT WESTERN RESERVOIR IHSS 200--SUBSURFACE SEDIMENT CORES
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 Background-Creek and Lake Surface Sediments Evaluation	4 Benchmark Lake Subsurface Sediments Evaluation	5 Spatial Analysis Performed?	6 Comments	7 PCOC
200	$^{239/240}Pu$	<MEAN+2SD,>MAX	>MAX	NO		YES
200	Selenium	<MEAN +2SD,<MAX	<MEAN	NO		NO
200	Silver	<MEAN+2SD,>MAX	NA	NO		NO
200	Sodium	<MEAN,<MAX	NA	NO		NO
200	Strontium	<MEAN+2SD,<MAX	NA	NO		NO
200	Thallium	ND	ND	NO		NO
200	Tin	<MEAN,<MAX	NA	NO		NO
200	$^{233/234}U$	<MEAN,<MAX	<MAX	NO	Creek Maximums Similar	NO
200	^{235}U	<MEAN,>MAX	<MAX	NO	Creek Maximums Similar	NO
200	^{238}U	<MEAN,<MAX	<MAX	NO		NO
200	Vanadium	<MEAN + 2SD,<MAX	>MEAN	NO		NO
200	Zinc	<MEAN+2SD,<MAX	>MEAN	NO		NO

Notes:
IHSS - Individual Hazardous Substance Site.
ND = Not detected.
N/A = Not analyzed in OU 3.
NA = Benchmark data not available.
*Chemical is an essential nutrient.
<Mean = OU 3 mean value is less than background or benchmark mean value.
>Mean = OU 3 mean value is greater than background or benchmark mean value.
<Max = OU 3 maximum value is less than background or benchmark maximum value.
>Max = OU 3 maximum value is greater than background or benchmark maximum value.
MAX = maximum value.
MEAN + 2SD = *upper bound background mean (i.e., mean plus two standard deviations).*

Column 3: Comparison of OU 3 reservoir to Background Geochemical Characterization Report stream sediments data (DOE, 1993c), Lowry Landfill Surface Stream Sediment data (EPA, 1992a), benchmark lake surface sediment data (CCBA, 1994).
Column 4: Comparison of OU 3 reservoir to benchmark lake subsurface sediment data (Heit, 1984; Cohen et al., 1990)
Column 5: N = No *spatial analysis performed*, y = *spatial analysis performed.*
Column 6: Discussion of weight-of-evidence evaluation.
Column 7: Yes = identified as a potential chemical of concern (PCOC), No = not a PCOC.

TABLE 2-5

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU3 SURFACE WATER
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 BGCR Evaluation	4 Benchark Evaluation	5 Spatial Analysis	6 PROBPLOT	7 Comments	8 PCOC?
200	Aluminum	<MEAN + 2SD, MAX	>MEAN,MAX	No Trend	Not Eval.		NO
201	Aluminum	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Aluminum	<MEAN, MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	^{241}Am	<MEAN + 2SD, MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	^{241}Am	<MEAN + 2SD, MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	^{241}Am	<MEAN + 2SD, MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Antimony	ND	ND	ND	Not Eval.		NO
201	Antimony	ND	ND	ND	Not Eval.		NO
202	Antimony	ND	ND	ND	Not Eval.		NO
200	Arsenic	MEAN,MAX	<MAX	No Trend	1 Population		NO
201	Arsenic	ND	ND	No Trend	1 Population		NO
202	Arsenic	~MEAN + 2SD,>MAX	<MAX	No Trend	1 Population		NO
200	Barium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Barium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Barium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Beryllium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
201	Beryllium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
202	Beryllium	ND	ND	ND	Not Eval.		NO
200	Cadmium	<MEAN.MAX	<MAX	No Trend	Not Eval.		NO
201	Cadmium	<MEAN,MAX	<MAX	No Trend	Not Eval.		NO
202	Cadmium	<MEAN,>MAX	>MAX	No Trend	Not Eval.		NO
200	Calcium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Calcium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Calcium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Cesium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
201	Cesium	ND	ND	ND	Not Eval.		NO
202	Cesium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
200	Chromium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Chromium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Chromium	<MEAN + 2SD,>MAX	>MEAN,MAX	No Trend	Not Eval.	1 anomalous value	NO
200	Cobalt	<MEAN,MAX	>MEAN,<MAX	No Trend	Not Eval.		NO
201	Cobalt	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Cobalt	ND	ND	ND	Not Eval.		NO
200	Copper	<MEAN + 2SD,>MAX	<MAX	No Trend	Not Eval.		NO
201	Copper	<MEAN + 2SD,>MAX	<MAX	No Trend	Not Eval.		NO
202	Copper	<MEAN,MAX	<MAX	No Trend	Not Eval.		NO
200	Cyanide	ND	ND	ND	Not Eval.		NO
201	Cyanide	<MEAN + 2SD,>MAX	NA	No Trend	Not Eval.	1 detect out of 16	NO
202	Cyanide	ND	ND	ND	Not Eval.		NO
200	Iron	<MEAN,MAX	>MEAN,MAX	No Trend	1 Population		NO

TABLE 2-5

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU3 SURFACE WATER
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1 IHSS	2 Chemical	3 BGCR Evaluation	4 Benchark Evaluation	5 Spatial Analysis	6 PROBPLOT	7 Comments	8 PCOC?
201	Iron	<MEAN,MAX	<MEAN,MAX	No Trend	1 Population		NO
202	Iron	<MEAN,MAX	<MEAN,MAX	No Trend	1 Population		NO
200	Lead	<MEAN + 2SD,<MAX	<MEAN,MAX	No Trend	1 Population		NO
201	Lead	<MEAN + 2SD,MAX	<MEAN.MAX	No Trend	1 Population		NO
202	Lead	>MEAN + 2SD,MAX	<MEAN,MAX	No Trend	1Population		NO
200	Lithium	<MEAN,MAX	>MEAN,MAX	No Trend	Not Eval.		NO
201	Lithium	<MEAN,MAX	>MEAN,MAX	No Trend	Not Eval.		NO
202	Lithium	<MEAN,MAX	>MEAN,MAX	No Trend	Not Eval.		NO
200	Magnesium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Magnesium	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Magnesium	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Manganese	<MEAN,MAX	<MEAN,MAX	No Trend	1 Population		NO
201	Manganese	<MEAN + 2SD,<MAX	<MEAN,>MAX	No Trend	1 Population		NO
202	Manganese	<MEAN,MAX	<MEAN,MAX	No Trend	1 Population		NO
200	Mercury	ND	ND	ND	Not Eval.		NO
201	Mercury	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Mercury	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Molybdenum	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Molybdenum	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Molybdenum	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Nickel	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Nickel	<MEAN,>MAX	<MEAN,>MAX	No Trend	Not Eval.		NO
202	Nickel	<MEAN,>MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	$^{239/240}Pu$	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	$^{239/240}Pu$	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	$^{239/240}Pu$	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Potassium	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Potassium	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Potassium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Selenium	ND	ND	ND	Not Eval.		NO
201	Selenium	<MEAN + 2SD,MAX	~MAX	No Trend	Not Eval.		NO
202	Selenium	ND	ND	ND	Not Eval.		NO
200	Silicon	<MEAN,MAX	NA	No Trend	1 Population		NO
201	Silicon	<MEAN.MAX	NA	No Trend	1 Population		NO
202	Silicon	<MEAN,MAX	NA	No Trend	1 Population		NO
200	Silver	ND	ND	ND	Not Eval.		NO
201	Silver	ND	ND	ND	Not Eval.		NO
202	Silver	ND	ND	ND	Not Eval.		NO
200	Sodium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	Sodium	>MEAN + 2SD, >MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Sodium	<MEAN + 2SD, >MAX	<MEAN,>MAX	No Trend	Not Eval.		NO
200	Strontium	<MEAN,MAX	<MEAN,>MAX	No Trend	Not Eval.		NO
201	Strontium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	Strontium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO

TABLE 2-5

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU3 SURFACE WATER
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6	7	8
IHSS	Chemical	BGCR Evaluation	Benchark Evaluation	Spatial Analysis	PROBPLOT	Comments	PCOC?
200	Thallium	ND	ND	ND	Not Eval.		NO
201	Thallium	ND	ND	ND	Not Eval.		NO
202	Thallium	ND	ND	ND	Not Eval.		NO
200	Tin	<MEAN,MAX	NA	No Trend	Not Eval.		NO
201	Tin	ND	ND	ND	Not Eval.		NO
202	Tin	<MEAN,MAX	NA	No Trend	Not Eval.		NO
200	Tritium	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	$^{233/234}U$	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	$^{233/234}U$	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	$^{233/234}U$	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	^{235}U	<MEAN + 2SD,>MAX	>MAX	No Trend	Not Eval.		NO
201	^{235}U	<MEAN + 2SD,MAX	>MAX	No Trend	Not Eval.		NO
202	^{235}U	<MEAN,MAX	>MAX	No Trend	Not Eval.		NO
200	^{238}U	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
201	^{238}U	<MEAN + 2SD,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
202	^{238}U	<MEAN,MAX	<MEAN,MAX	No Trend	Not Eval.		NO
200	Vanadium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
201	Vanadium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
202	Vanadium	<MEAN,MAX	NA	No Trend	Not Eval.		NO
200	Zinc	<MEAN + 2SD,<MAX	>MEAN,MAX	No Trend	Not Eval.		NO
201	Zinc	<MEAN + 2SD,<MAX	>MEAN,MAX	No Trend	Not Eval.		NO
202	Zinc	<MEAN + 2SD,<MAX	<MEAN,MAX	No Trend	Not Eval.		NO

Notes:
IHSS - Individual Hazardous Substance Site.
ND = Not detected.
NA = No literature data available.
<MEAN = OU 3 mean value is less than background or benchmark mean value.
>MEAN = OU 3 mean value is greater than background or benchmark mean value.
<MEAN, MAX = OU 3 mean and maximum values are less than background or benchmark mean and maximum values.
>MEAN, MAX = OU 3 mean and maximum values are greater than background or benchmark mean and maximum values.
MAX = maximum value.
MEAN + 2SD = upper-bound background mean (i.e., mean plus two standard deviations).
Column 3: Comparison of OU 3 stream to Background Geochemical Charact. Report stream data.
Column 4: Comparison of OU 3 reservoir to benchmark lake data.
Column 5: No Trend = spatial analyses indicates no contamination from RFP. Spatial distribution is consistent with physical properties associated with natural deposition.
Column 6: PROBPLOT results. PROBPLOT is used to assess the number of populations within data set.
Column 7: Discussion of weight-of-evidence evaluation results.
Column 8: No = chemical not identified as a potential chemical of concern.

- The mean and maximum values for strontium in OU 3 groundwater exceed corresponding mean and maximum values for BGCR groundwater samples.

- The maximum value for strontium in OU 3 groundwater exceeds the maximum benchmark value.

Table 2-6 summarizes the results of the weight-of-evidence evaluations for all groundwater analytes. In general, most OU 3 values are less than corresponding background and benchmark values. Columns 3 and 4 in Table 2-6 show comparisons of OU 3 data to BGCR groundwater data (upper and lower flow systems) and benchmark data, respectively; mean and maximum values for the corresponding OU 3 and background/benchmark data sets were compared. Columns 5 and 6 report summary comments and whether the chemical is carried through the CDPHE Conservative Screen (i.e., is identified as a PCOC), respectively.

The comparisons of OU 3 groundwater data (IHSS 200) to background and benchmark data indicate that mean and maximum concentrations of potassium in IHSS 200 exceed corresponding BGCR data, and the maximum concentration exceeds the literature benchmark value. Although OU 3 values exceed background and benchmark values, potassium was not retained as a PCOC for the remaining steps of the CDPHE Conservative Screen because potassium is considered to be an essential human nutrient and is not evaluated for risk (EPA, 1989a). TM 4 includes a discussion of the elimination of five essential nutrients as COCs.

TABLE 2-6

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 GROUNDWATER
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6
IHSS	Chemical	Background Geo. Char. (49192/Upper, 49292/Lower)	Benchmark Evaluation	COMMENTS	PCOC?
200	ALUMINUM	<MEAN + 2SD,>MAX	>MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	ALUMINUM	<MEAN,MAX	<MAX		NO
200	^{241}AM	<MEAN,MAX	NA		NO
201	^{241}AM	<MEAN,MAX	NA		NO
200	ANTIMONY	<MEAN,MAX	NA		NO
201	ANTIMONY	ND	ND		NO
200	ARSENIC	<MEAN + 2SD,>MAX	<MAX		NO
201	ARSENIC	<MEAN,MAX	<MAX		NO
200	BARIUM	<MEAN,MAX	<MAX		NO
201	BARIUM	<MEAN,MAX	<MAX		NO
200	BERYLLIUM	<MEAN,MAX	<MAX		NO
201	BERYLLIUM	ND	ND		NO
200	CADMIUM	<MEAN + 2SD,<MAX	>MAX	MEANS SIMILAR, 1 DETECT	NO
201	CADMIUM	ND	ND		NO
200	CALCIUM	>MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
201	CALCIUM	>MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
200	CESIUM	<MEAN,MAX			NO
201	CESIUM	ND			NO
200	CHROMIUM	<MEAN + 2SD,<MAX	>MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	CHROMIUM	<MEAN,MAX	<MAX		NO
200	COBALT	<MEAN,MAX	>MAX		NO
201	COBALT	ND	ND		NO
200	COPPER	<MEAN + 2SD,<MAX	>MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	COPPER	<MEAN,MAX	<MAX		NO
200	IRON	<MEAN + 2SD,MAX	>MAX	3 ROUNDS ELEVATED DUE TI HIGH TSS	NO
201	IRON	<MEAN,MAX	<MAX		NO
200	LEAD	<MEAN + 2SD,<MAX	>MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	LEAD	<MEAN,MAX	<MAX		NO
200	LITHIUM	>MEAN + 2SD,MAX	<MAX	LITERATURE VALUE FROM MATHESS 1989	NO
201	LITHIUM	<MEAN + 2SD,MAX	<MAX	LITERATURE VALUE FROM MATHESS 1989	NO
200	MAGNESIUM	>MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
201	MAGNESIUM	>MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
200	MANGANESE	>MEAN + 2SD,MAX	<MAX		NO
201	MANGANESE	<MEAN,MAX	<MAX		NO
200	MERCURY	ND	ND		NO
201	MERCURY	ND	ND		NO
200	MOLYBDENUM	ND	ND		NO
201	MOLYBDENUM	<MEAN,MAX	<MAX		NO
200	NICKEL	<MEAN + 2SD,MAX	<MAX		NO
201	NICKEL	ND	ND		NO
200	$^{239/240}$PU	<MEAN + 2SD,MAX	NA		NO
201	$^{239/240}$PU	<MEAN + 2SD,MAX	NA		NO
200	POTASSIUM	>MEAN + 2SD,>MAX	>MAX	WATER TYPING; ESSENTIAL NUTRIENT; CONCENTRATION CORRESPONDS TO A SAFE DOSE	NO
201	POTASSIUM	<MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
200	SELENIUM	<MEAN,MAX	<MAX		NO
201	SELENIUM	ND	ND		NO
200	SILICON	<MEAN + 2SD,>MAX	<MAX	OU 3 MAXIMUM SLIGHTLY GREATER	NO
201	SILICON	<MEAN,MAX	<MAX		NO

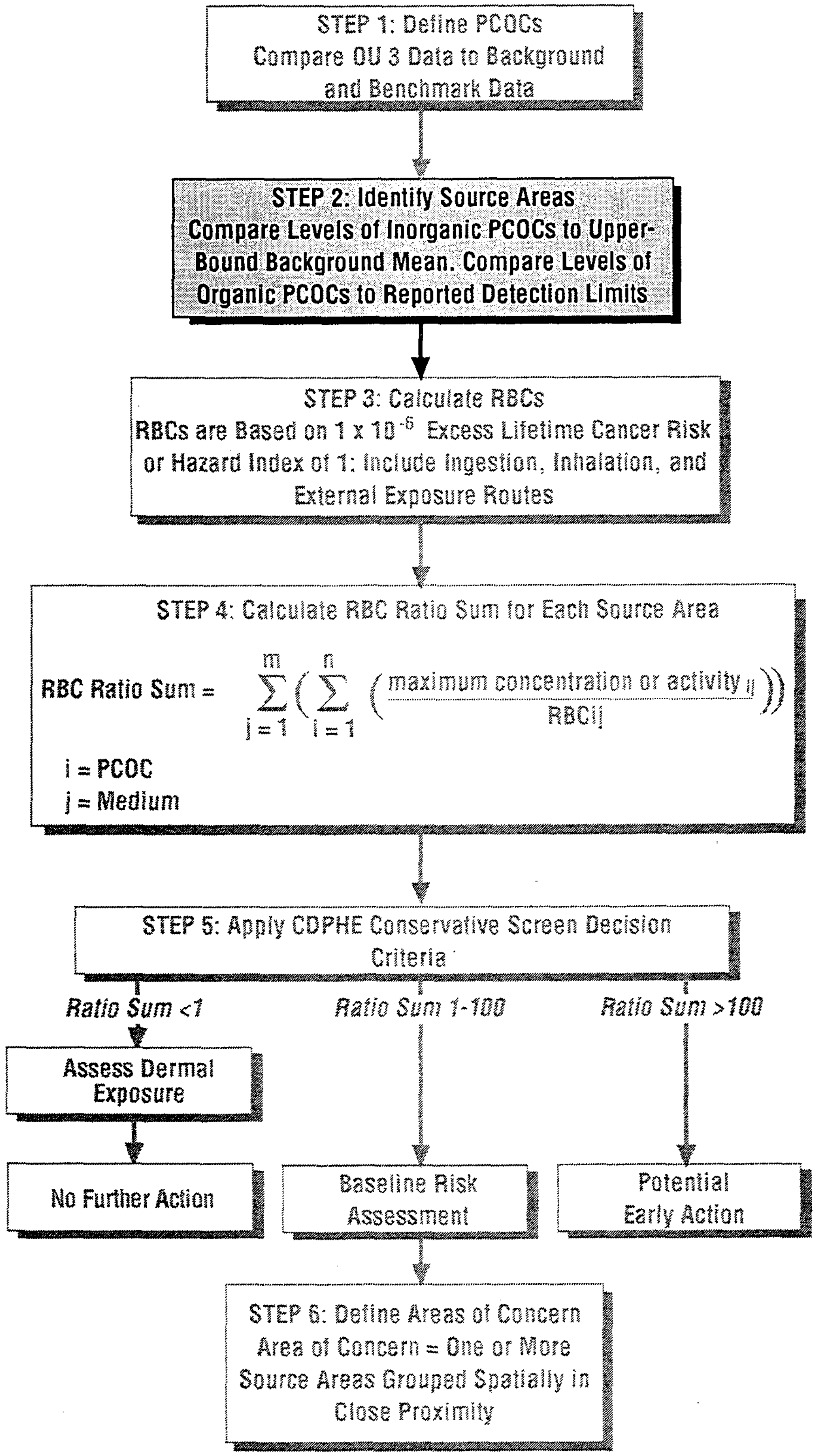
TABLE 2-6

WEIGHT-OF-EVIDENCE EVALUATION SUMMARY
OU 3 GROUNDWATER
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

1	2	3	4	5	6
IHSS	**Chemical**	**Background Geo. Char. (49192/Upper, 49292/Lower)**	**Benchmark Evaluation**	**COMMENTS**	**PCOC?**
200	SILVER	ND	ND		NO
201	SILVER	ND	ND		NO
200	SODIUM	>MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
201	SODIUM	<MEAN + 2SD,MAX	<MAX	WATER TYPING	NO
200	STRONTIUM	>MEAN + 2SD,MAX	>MAX		YES
201	STRONTIUM	>MEAN + 2SD,MAX	<MAX		NO
200	THALLIUM	ND	ND		NO
201	THALLIUM	ND	ND		NO
200	TIN	<MEAN,MAX	<MAX		NO
201	TIN	ND	ND		NO
200	$^{233/234}U$	<MEAN,MAX	NA		NO
201	$^{233/234}U$	<MEAN,MAX	NA		NO
200	^{235}U	<MEAN,MAX	NA		NO
201	^{235}U	<MEAN + 2SD,>MAX	NA	MEAN < UPPER BACKGROUND MEAN, MAX	NO
200	^{238}U	<MEAN,MAX	NA		NO
201	^{238}U	<MEAN + 2SD,>MAX	NA	MEAN < UPPER BACKGROUND MEAN,MAX	NO
200	VANADIUM	<MEAN + 2SD,MAX	>MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	VANADIUM	ND	ND		NO
200	ZINC	<MEAN + 2SD,MAX	<MAX	3 ROUNDS ELEVATED DUE TO HIGH TSS	NO
201	ZINC	<MEAN,MAX	<MAX		NO

Notes:
IHSS = Individual Hazardous Substance Site.
< MEAN = OU 3 mean value is less than background or benchmark mean value.
> MEAN = OU 3 mean value is greater than background or benchmark mean value.
<MAX = OU 3 Maximum value is less than background or benchmark maximum value.
>MAX = OU 3 Maximum value is greater than background or benchmark maximum value.
<MEAN, MAX = OU 3 mean and maximum values are less than background or benchmark mean and maximum values.
>MEAN, MAX = OU 3 mean and maximum values are greater than background or benchmark mean and maximum values.
MAX = maximum value.
MEAN + 2SD = Upper bound background mean (i.e., mean plus two standard deviations).
TSS = Total suspended solids.
Column 3: Comparison of OU 3 groundwater data to Background Geochemical Characterization Report. IHSS 200 compared to upper flow regime and IHSS 201 compared to lower flow regime
Column 4: Comparison of OU 3 groundwater data to benchmark lake data.
Column 5: Discussion of weight-of-evidence results.
Column 6: YES = chemical was identified as a potential chemical of concern (PCOC). NO = not a PCOC.

Section 3.0
STEP 2: SOURCE AREA IDENTIFICATION



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

3.0 STEP 2: SOURCE AREA IDENTIFICATION

The purpose of Step 2 of the CDPHE Conservative Screen is to delineate areas of each IHSS within the OU where concentrations or activities of each PCOC exceed an upper-bound background value (i.e., background mean plus two standard deviations); these areas are then designated as "Source Areas." The Source Areas identified by this step can represent potential contamination associated with primary sources located within the OU, or as is the case for OU 3, secondary sources resulting from deposition of chemicals that have migrated from primary sources outside of OU 3.

As discussed in Section 2.0, surface soil is the only OU 3 medium that has a background data set suitable for rigorous statistical comparisons. Therefore, this step of the CDPHE Conservative Screen Process was performed only for IHSS 199. For Great Western Reservoir, the entire IHSS was considered as a Source Area for subsequent steps in the CDPHE Conservative Screen because the IHSS is a spatially discrete water body, including individual drainages associated with the reservoir (Figure 3-1 shows the location of Great Western Reservoir [IHSS 200]. Because no PCOCs were identified for IHSSs 201 or 202, those IHSSs were not evaluated further in the CDPHE Conservative Screen for OU 3.

For this step, ^{241}Am and $^{239/240}$Pu activities at each surface-soil sampling location, including RFI/RI and Jefferson County Remedy Acres sampling plots, were compared to their respective upper-bound background values (i.e., 0.04 picocuries per gram [pCi/g] for ^{241}Am and 0.09 pCi/g for $^{239/240}$Pu). Nineteen out of 61 RFI/RI sample locations (Figure 3-1) and all 47 Jefferson County Remedy Acres locations (Figure 3-2) have either ^{241}Am or $^{239/240}$Pu activities that exceed the upper-bound background values and, therefore, were identified as Source Areas for OU 3. Figures 3-1 and 3-2 also show all RFI/RI and Jefferson County Remedy Acres locations, respectactively. (Figure 3-2 shows two locations for T8 which is a composited sample.) The left half of the symbols on the figures show the results of the comparison of the ^{241}Am activity at each location to the upper-bound ^{241}Am background value. The right half of the symbols show the results of the comparison of the $^{239/240}$Pu activity at each location to the upper-bound $^{239/240}$Pu background value. Blue symbols indicate a sample location with an activity greater than the upper-bound background value. Green symbols represent sample locations that do not exceed upper-bound background values; 42 of the 61 RFI/RI locations have ^{241}Am and $^{239/240}$Pu activities that do not exceed upper-bound background values. Table 3-1 summarizes ^{241}Am and $^{239/240}$Pu activities for each surface-soil sampling location.

TABLE 3-1

AMERICIUM^{241} AND PLUTONIUM$^{239/240}$ ACTIVITIES FOR OU3 SURFACE-SOIL LOCATIONS ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Location Code	Americium^{241} (pCi/g)	Plutonium$^{239/240}$ (pCi/g)
PT12592	0.012	0.029
PT12692	0.012	0.023
PT12792	0.029	0.132
PT12892	0.030	0.036
PT12992	R	0.020
PT13092	0.021	0.047
PT13192	0.028	0.069
PT13292	0.008	0.017
PT13392	0.011	0.041
PT13492	0.003	0.030
PT13592	0.062	0.205
PT13792	0.011	0.034
PT14092	0.010	0.021
PT14192	0.520	2.950
PT14292	0.013	0.280
PT14392	0.020	0.270
PT14492	0.033	0.015
PT14592	0.030	0.068
PT14692	0.013	0.035
PT14792	0.006	0.013
PT14892	0.001	0.008
PT14992	0.023	0.095
PT15092	0.036	0.160
PT15192	0.081	0.745
PT15292	0.095	0.511
PT15392	0.034	0.215
PT15492	0.026	0.055
PT15592	0.013	0.041
PT15692	0.019	0.036
PT15792	-0.002	0.012
PT15892	0.004	0.042
PT15992	0.006	0.282
PT16092	0.004	0.041
PT16192	0.016	0.052
PT16292	0.068	0.089
PT16392	0.054	0.115
PT16492	0.008	0.024
PT16592	0.013	0.034
PT16692	0.027	0.040
PT16792	0.001	0.020
PT16992	0.003	0.028
PT17092	0.011	0.031
PT17192	0.026	0.016
PT17292	R	0.085
PT17392	0.005	0.034

TABLE 3-1

AMERICIUM^{241} AND PLUTONIUM$^{239/240}$ ACTIVITIES FOR OU3 SURFACE-SOIL LOCATIONS ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Location Code	Americium^{241} (pCi/g)	Plutonium$^{239/240}$ (pCi/g)
PT17492	0.002	0.017
PT17692	0.004	0.012
PT17792	0.008	0.074
PT17992	0.014	0.059
PT18592	0.099	0.665
PT18692	0.036	0.735
PT18792	0.011	0.051
PT18892	0.013	0.021
PT18992	R	0.019
PT19092	0.009	0.032
PT19192	0.038	0.148
PT19292	0.166	0.321
PT19392	R	0.014
PT19492	0.077	0.087
PT19592	0.052	0.250
PT19692	0.006	0.009
T1A	R	0.952
T1B	R	1.475
T2A	R	0.757
T2B	R	0.681
T2C	R	1.600
T3A	R	0.923
T3B	R	0.734
T3C	R	0.656
T4A	0.161	0.808
T4B	0.078	0.365
T5	0.128	0.566
T6	0.060	0.476
T7	0.056	0.162
T8	0.041	0.225
T9	0.114	0.592
T10	0.053	0.249
T11	0.065	0.480
T12A	0.049	0.288
T12B	0.048	0.356
T13A	0.200	0.891
T13B	0.095	0.686
T14A	0.100	0.608
T14B	0.088	0.432
T15A	0.213	1.336
T15B	0.140	1.084
U1A	R	6.468
U1B	R	2.672
U2A	R	3.590
U2B	R	1.219
U3A	0.279	1.696
U3B	0.260	1.190

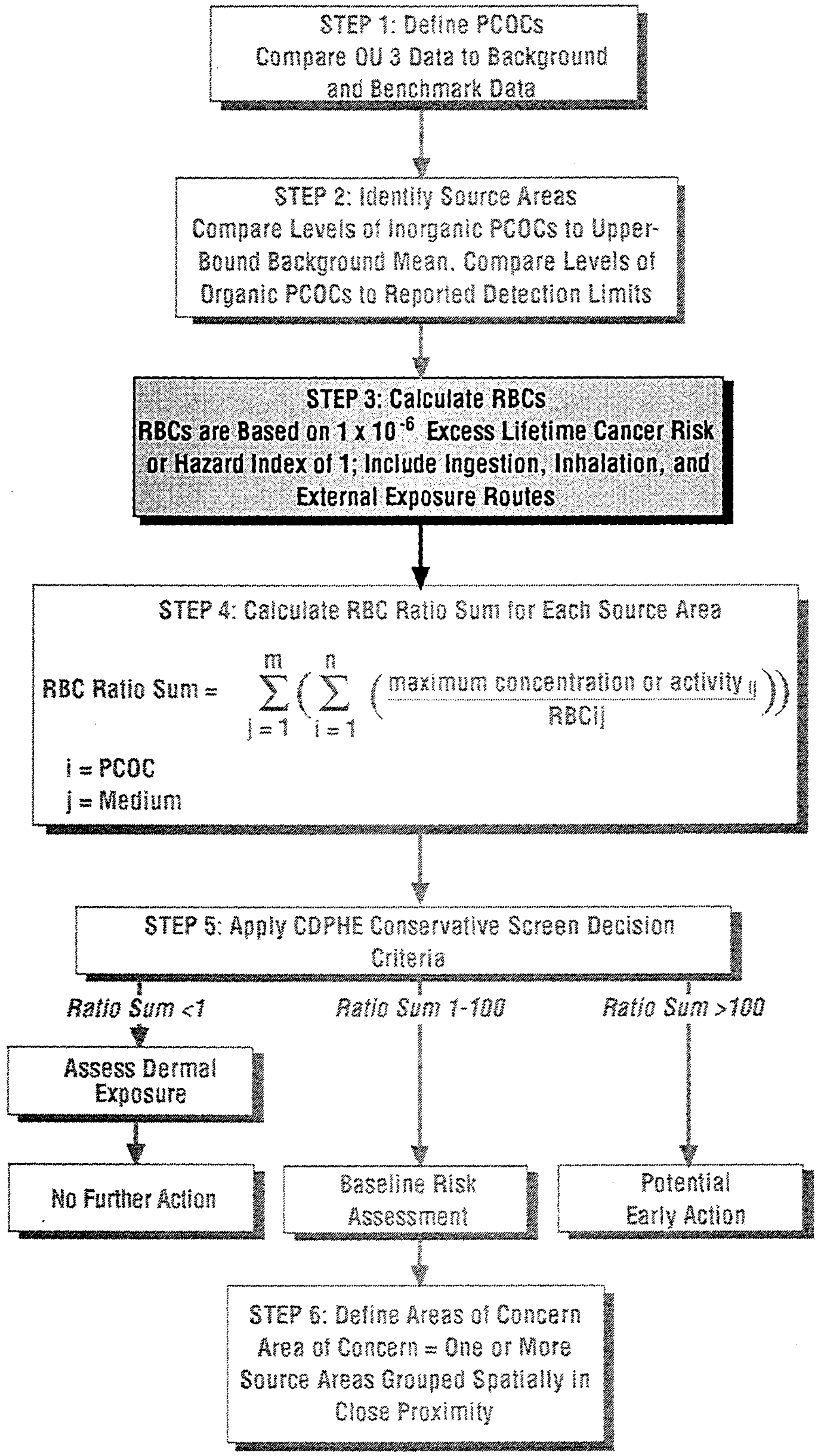
TABLE 3-1

AMERICIUM^{241} AND PLUTONIUM$^{239/240}$ ACTIVITIES FOR OU3 SURFACE-SOIL LOCATIONS ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Location Code	Americium^{241} (pCi/g)	Plutonium$^{239/240}$ (pCi/g)
U4	0.099	0.178
U5	0.118	0.412
U6	0.101	0.423
U7	0.268	1.151
U8	0.150	0.201
U9	0.306	1.857
U10A	0.363	1.739
U10B	0.229	1.089
U11A	0.112	0.718
U11B	0.141	0.771
U12A	0.195	0.972
U12B	0.122	0.742
U13A	0.197	1.272
U13B	0.159	0.762
U14A	0.138	0.683
U14B	0.161	0.989

Notes:
pCi/g = picocuries per gram.
R = Analytical result was rejected by data validators.
T = tilled.
U = untilled.

Section 4.0
STEP 3: RISK-BASED CONCENTRATION CALCULATIONS



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

4.0 STEP 3: RISK-BASED CONCENTRATION CALCULATIONS

The RBCs presented in the Final Rocky Flats Programmatic Risk-Based Preliminary Remediation Goals (DOE, 1994c) were used for Step 3 of the CDPHE Conservative Screen for OU 3. The purpose of the Programmatic Preliminary Remediation Goals (PRGs) document was to develop initial sitewide cleanup levels (chemical- and medium-specific) for RFETS that are protective of human health and the environment (DOE, 1994c). The PRGs also were developed to be used as RBCs in the data aggregation process for HHRAs.

The RBCs used in the CDPHE Conservative Screen for OU 3 are based on a residential scenario for soil, sediment, and groundwater. A target risk of 1×10^{-6} was used for carcinogenic chemicals and a target Hazard Index of 1 was used for noncarcinogenic chemicals to calculate the RBCs. The RBCs are based on exposure via the ingestion, inhalation, and external exposure (radionuclides only) pathways. Table 4-1 summarizes the RBCs for each PCOC in surface soil, surface sediment, subsurface sediment, and groundwater. RBCs were not calculated for surface water since no surface water PCOCs were identified.

TABLE 4-1

**RISK-BASED CONCENTRATIONS FOR
OU 3 PCOCs
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE**

Medium	IHSS	PCOCs	Risk Based Concentrations
Surface Soil	199	^{241}Am	2.37 pCi/g
		$^{239/240}Pu$	3.43 pCi/g (assumes ^{239}Pu)
Surface Sediment (Grab Samples)	200	$^{239/240}Pu$	3.43 pCi/g (assumes ^{239}Pu)
	201	None	-
	202	None	
Subsurface Sediment (Core Samples)	200	Copper	11,000 mg/kg
		$^{239/240}Pu$	3.43 pCi/g (assumes ^{239}Pu)
Surface Water	200	None	NA
	202	None	NA
Groundwater	200	Strontium	21.9 mg/L
	201	None	NA

Notes:
PCOCs = Inorganic chemicals with detected levels above background levels or organic chemicals detected above detection limits.

NA = Not applicable.
PCOC = Potential Chemical of Concern.

Section 5.0

STEP 4: RATIO OF MAXIMUM CONCENTRATIONS TO RISK-BASED CONCENTRATIONS

STEP 1: Define PCOCs
Compare OU 3 Data to Background and Benchmark Data

↓

STEP 2: Identify Source Areas
Compare Levels of Inorganic PCOCs to Upper-Bound Background Mean. Compare Levels of Organic PCOCs to Reported Detection Limits

↓

STEP 3: Calculate RBCs
RBCs are Based on 1×10^{-6} Excess Lifetime Cancer Risk or Hazard Index of 1: Include Ingestion, Inhalation, and External Exposure Routes

↓

STEP 4: Calculate RBC Ratio Sum for Each Source Area

$$\text{RBC Ratio Sum} = \sum_{j=1}^{m}\left(\sum_{i=1}^{n}\left(\frac{\text{maximum concentration or activity}_{ij}}{\text{RBC}ij}\right)\right)$$

i = PCOC
j = Medium

↓

STEP 5: Apply CDPHE Conservative Screen Decision Criteria

- *Ratio Sum <1* → **Assess Dermal Exposure** → **No Further Action**
- *Ratio Sum 1-100* → Baseline Risk Assessment → STEP 6
- *Ratio Sum >100* → Potential Early Action

STEP 6: Define Areas of Concern
Area of Concern = One or More Source Areas Grouped Spatially in Close Proximity

CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

5.0 STEP 4: RATIO OF MAXIMUM CONCENTRATIONS TO RISK-BASED CONCENTRATIONS

For Step 4 of the CDPHE Conservative Screen, the following ratio was calculated for each PCOC per medium in each Source Area identified in Step 2:

$$RBC\ Ratio = \frac{Maximum\ detected\ concentration\ or\ activity\ of\ PCOC}{RBC\ for\ PCOC}$$

The PCOC-specific ratios were then summed for each medium within a Source Area. Carcinogenic-PCOC ratios and noncarcinogenic-PCOC ratios were summed separately because exposures to these two types of PCOCs result in different adverse health effects. Finally, the medium-specific ratios were summed for each Source Area to produce RBC Ratio Sums (i.e., RBC Ratio Sum-C = RBC Ratio Sum for carcinogenic PCOCs; RBC Ratio Sum-NC = RBC Ratio Sum for noncarcinogenic PCOCs) for the Source Areas according to the following formula:

$$RBC\ Ratio\ Sum = \sum_{j=1}^{m} \left(\sum_{i=1}^{n} (maximum\ concentration\ or\ activity_{i,j} / RBC_{i,j}) \right)$$

where

RBC = risk-based concentration
j = medium
i = PCOC
maximum concentration or activity = maximum concentration or activity in the Source Area

Three of the surface-soil Source Areas identified in Step 2 have RBC Ratio Sums greater than 1 (sample locations: PT14192, U1A, and U2A). The RBC Ratio Sums for these areas range from

1 to 2. Figure 5-1 shows RBC Ratio Sums for all RFI/RI surface-soil sampling locations. Blue symbols indicate that a surface-soil location has a RBC Ratio Sum greater than 1. Green symbols indicate surface-soil locations with Ratio Sums less than 1; 18 of the 19 RFI/RI surface soil Source Areas have RBC Ratio Sums less than 1. Figure 5-2 shows Ratio Sums for the Jefferson County Remedy Acres surface-soil locations. Forty-five of the 47 Jefferson County Remedy Acres Source Areas have RBC Ratio Sums less than 1. Table 5-1 summarizes the RBC Ratio Sums for the 20 RFI/RI and 47 Jefferson County Remedy Acres surface-soil Source Areas. Table D-1 in Appendix D shows PCOC-specific ratios, RBCs, and toxicity values for all surface-soil Source Areas.

RBC Ratio Sums for Great Western Reservoir (IHSS 200) were calculated using maximum values of PCOCs from all sediment data (surface and subsurface samples). The RBC Ratio Sum-C for Great Western Reservoir is greater than 1 and the RBC Ratio Sum-NC is less than 1.

Table 5-2 summarizes the Ratio Sums for Great Western Reservoir (IHSS 200). Table D-2 in Appendix D shows PCOC-specific RBC ratios and toxicity values for IHSS 200. PCOC-specific RBC ratios or RBC Ratio Sums were not calculated for IHSSs 201 or 202 because no PCOCs were identified for those IHSSs.

TABLE 5-1

RBC RATIO SUMS FOR OU 3 SURFACE SOIL SOURCE AREAS
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Location Code	Ratio Sum	Location Code	Ratio Sum
PT12792	0.05	T2C	0.5
PT13592	0.09	T3A	0.3
PT14192	1	T3B	0.2
PT14292	0.1	T3C	0.2
PT14392	0.1	T4A	0.3
PT14992	0.04	T4B	0.1
PT15092	0.06	T5	0.2
PT15192	0.3	T6	0.2
PT15292	0.2	T7	0.07
PT15392	0.08	T8	0.08
PT15992	0.08	T9	0.2
PT16292	0.05	U10A	0.7
PT16392	0.06	U10B	0.4
PT18592	0.2	U11A	0.3
PT18692	0.2	U11B	0.3
PT19192	0.06	U12A	0.4
PT19292	0.2	U12B	0.3
PT19492	0.06	U13A	0.5
PT19592	0.09	U13B	0.3
T10	0.1	U14A	0.3
T11	0.2	U14B	0.4
T12A	0.1	U1A	2
T12B	0.1	U1B	0.8
T13A	0.3	U2A	1
T13B	0.2	U2B	0.4
T14A	0.2	U3A	0.6
T14B	0.2	U3B	0.5
T15A	0.5	U4	0.1
T15B	0.4	U5	0.2
T1A	0.3	U6	0.2
T1B	0.4	U7	0.4
T2A	0.2	U8	0.1
T2B	0.2	U9	0.7

Notes:
RBC = Risk Based Concentration.

$$\text{RBC Ratio Sum} = \frac{{}^{241}\text{Am activity}}{\text{RBC}} + \frac{{}^{239/240}\text{Pu activity}}{\text{RBC}}$$

TABLE 5-2

SOURCE AREA RBC RATIO SUMS FOR IHSS 200 SEDIMENTS AND GROUNDWATER ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Source Area	Medium	RBC Ratio Sum - C	RBC Ratio Sum - NC
IHSS 200	Sediments	1[a]	0.03[b]
IHSS 200	Groundwater		0.3[c]
TOTAL		1	0.3

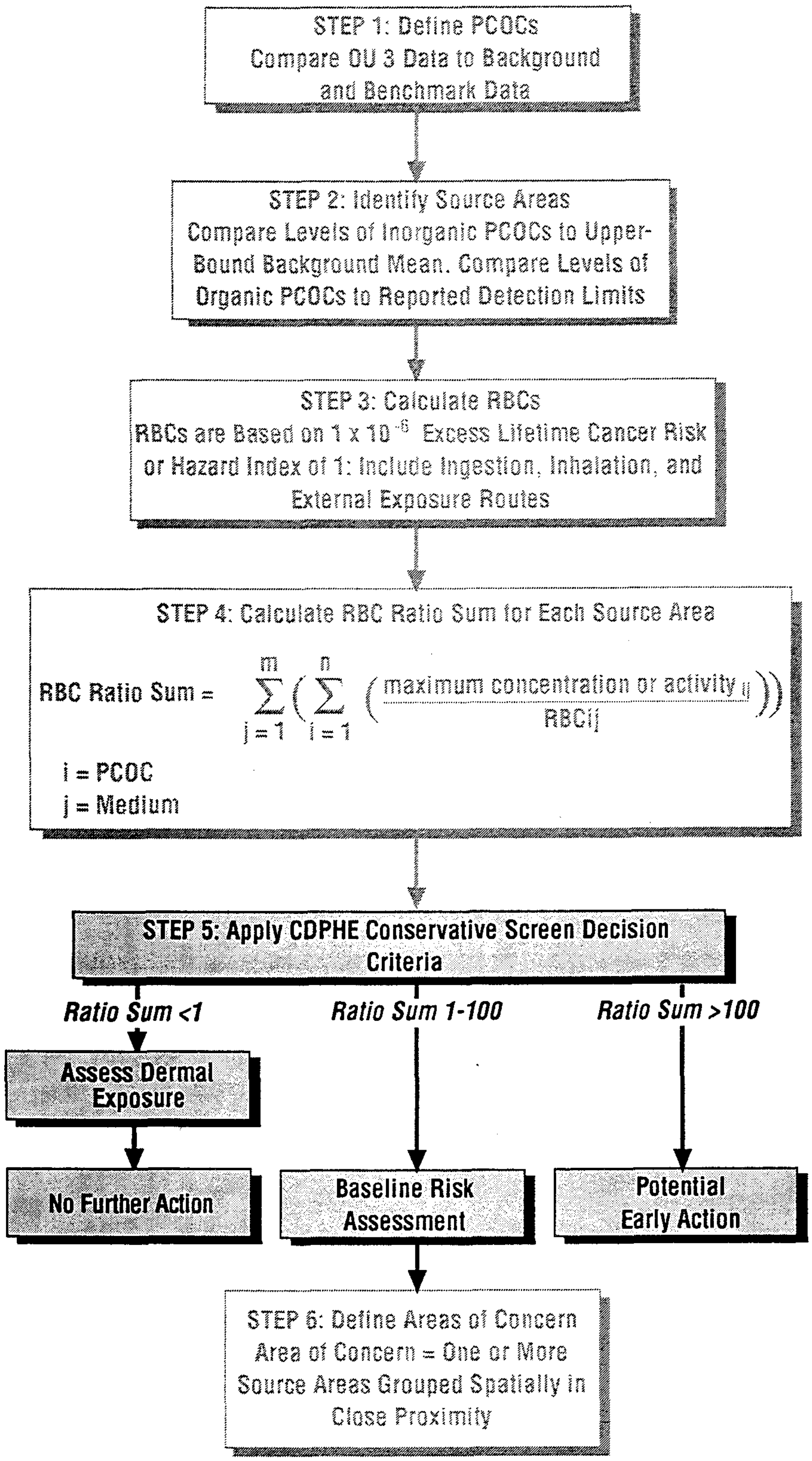
Notes:
C = Carcinogenic potential contaminants.
NC = Noncarcinogenic potential contaminants.
IHSS = Individual Hazardous Substance Site.
mg/L = milligrams per liter.
pCi/g = picocuries per gram.

[a]For $^{239/240}$Pu: $\frac{4.04 \text{ pCi/g}}{3.43 \text{ pCi/g}} = 1$

[b]For Cu: $\frac{311 \text{ mg/kg}}{11{,}000 \text{ mg/kg}} = 0.03$

[c]For Sr: $\frac{5.59 \text{ mg/L}}{21.9 \text{ mg/L}} = 0.3$

Section 6.0
STEP 5: CDPHE CONSERVATIVE SCREEN DECISION CRITERIA



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

6.0 STEP 5: CDPHE CONSERVATIVE SCREEN DECISION CRITERIA

Further actions for Source Areas are determined by the following decision criteria (CDPHE/EPA/DOE, 1994):

- If the RBC Ratio Sum for a Source Area is greater than or equal to 100, DOE may conduct a Voluntary Corrective Action for that portion of the OU.

- If the RBC Ratio Sum for a Source Area is between 1 and 100, DOE must conduct an HHRA for that Source Area, in accordance with Risk Assessment Guidance for Superfund (EPA, 1989a).

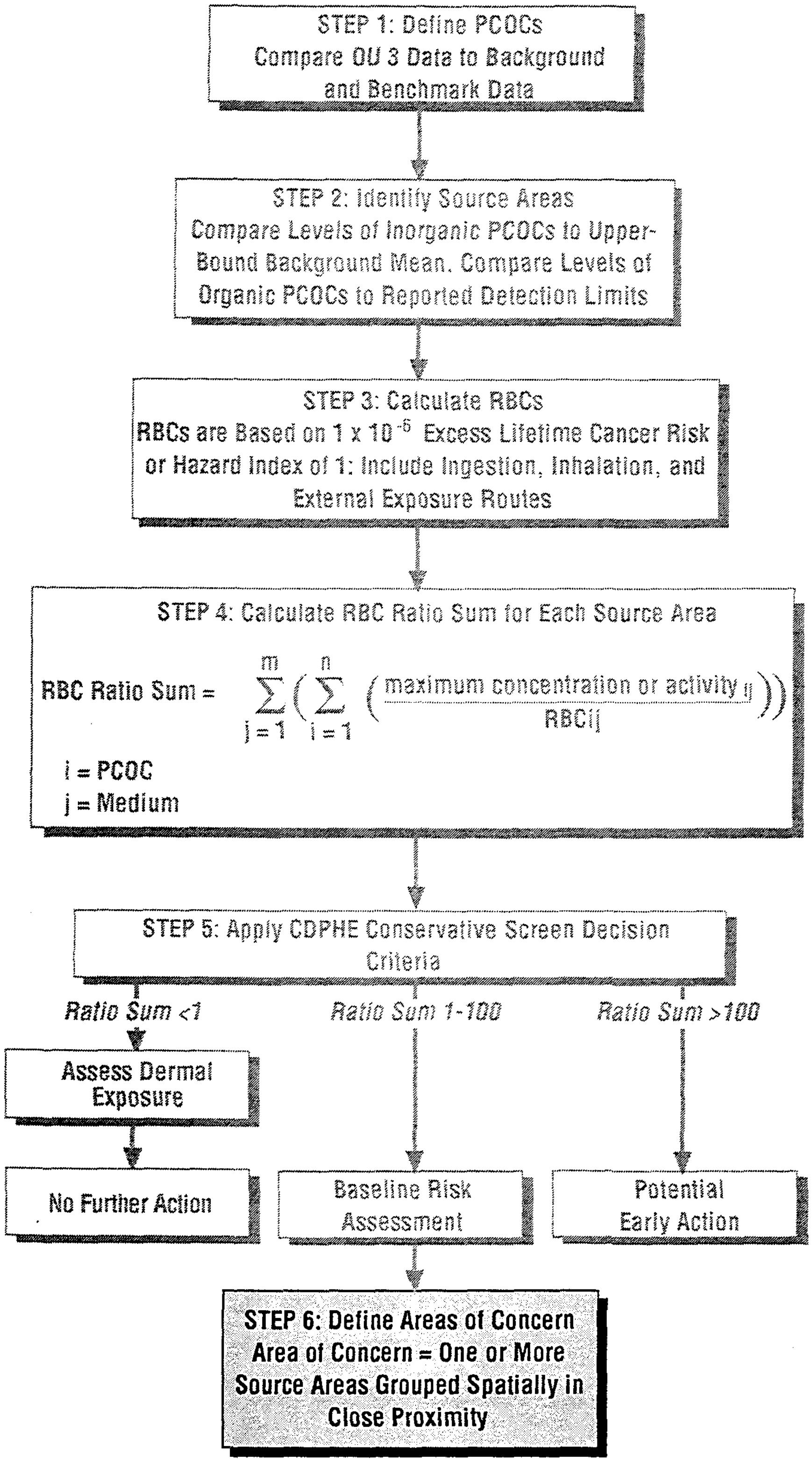
- If the RBC Ratio Sum for a Source Area is less than or equal to 1, no further action (i.e., a HHRA is not required) is required pending an evaluation of dermal exposure.

All RBC Ratio Sums for surface-soil Source Areas in OU 3 are either less than 1 (i.e., no further action is required pending dermal exposure evaluation) or in the 1 to 100 range (i.e., further evaluation in a HHRA is required). For those surface-soil Source Areas with RBC Ratio Sums less than 1, the CDPHE Conservative Screen decision criteria include an evaluation of dermal exposure. Dermal contact with surface soil in OU 3 is not considered to be a significant exposure pathway because radionuclides are not expected to be significantly absorbed through the skin (EPA, 1989a; EPA, 1989b). As a screening step to verify the assumption that dermal contact is not a significant exposure pathway, maximum activities of ^{241}Am and $^{239/240}$Pu for surface-soil samples in each Source Area with a RBC Ratio Sum less than 1 were compared to a Dermal RBC (i.e., RBC based on exposure via dermal absorption). No activities for surface-soil samples in the OU 3 data set exceed the Dermal RBCs. The methods used to calculate the Dermal RBCs are presented in Appendix E, along with the results of the comparison.

The RBC Ratio Sum-C for the Great Western Reservoir (IHSS 200) Source Area is greater than 1. Therefore, further evaluation in a HHRA is required for Great Western Reservoir.

Based on the conservative screening process specified by CDPHE and the decision criteria described above, three surface-soil Source Areas (sample locations: PT14192, U1A, and U2A) and the Great Western Reservoir (IHSS 200) Source Area, require further evaluation in a HHRA. No further action is required for all other surface-soil Source Areas (18 RFI/RI soil-sampling locations and 45 Jefferson County Remedy Acres locations). In addition, no further action is required for Standley Lake (IHSS 201) or Mower Reservoir (IHSS 202) because no PCOCs were identified for those IHSSs.

Section 7.0
STEP 6: AREAS OF CONCERN



CDPHE = Colorado Department of Public Health and Environment

PCOC = Potential Chemical of Concern

RBC = Risk-Based Concentration

CDPHE CONSERVATIVE SCREEN PROCESS

7.0 STEP 6: AREAS OF CONCERN

Areas of Concern are defined as one or several Source Areas grouped spatially in close proximity (CDPHE/EPA/DOE, 1994). In the HHRA for OU 3, the three surface-soil Source Areas with RBC Ratio Sums greater than 1 (sample locations: PT14192, U1A, and U2A) will be considered as separate Areas of Concern because each of the three Source Areas represents an area large enough to be considered a single residential exposure area (i.e., approximately 10 acres), and the Source Areas are separated by areas that have RBC Ratio Sums less than 1 (i.e., tilled strips of the Jefferson County Remedy Acres). The Great Western Reservoir (IHSS 200) Source Area is considered an Area of Concern because the RBC Ratio Sum-C is greater than 1.

Section 8.0
REFERENCES

8.0 REFERENCES

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Appendix A
CDPHE/EPA/DOE GUIDANCE FOR CDPHE CONSERVATIVE SCREEN

APPENDIX A. CDPHE/EPA/DOE GUIDANCE FOR THE CDPHE CONSERVATIVE SCREEN

Appendix A contains copies of the following CDPHE/EPA/DOE guidance for the CDPHE Conservative Screen:

Attachment 1. Memorandum from Jessie Roberson (DOE, Memo Reference No. ER:SRG:03600), dated March 30, 1994, describing Data Aggregation methodologies, including the CDPHE Conservative Screen.

Attachment 2. Presentation materials from a meeting on June 3, 1994 sponsored by CDPHE, EPA, and DOE. The Data Aggregation process for RFP HHRAs was described at this meeting, including the CDPHE Conservative Screen and the COC selection process.

Attachment 3. Memorandum from Martin Hestmark (EPA) confirming the background comparison methodologies to be used for OU 3 (i.e., weight-of-evidence evaluations for analytes in reservoirs) as part of the Data Aggregation process.

DOE F 1325.8

United States Government Department of Energy

memorandum

Rocky Flats Office

COPY

DATE: MAR 3 0 1994

REPLY TO ATTN OF: ER:SRG:03600

SUBJECT: Resumption of All Work on Operable Unit Baseline Risk Assessments

TO: Sue Stiger, Associate General Manager
Environmental Restoration Management
EG&G Rocky Flats, Inc.

Memorandum ER:SRG:03599 provides instruction for you to resume all work associated with Environmental Restoration Operable Unit (OU) baseline risk assessments that were stopped by memorandum ERD:SRG:08450, dated August 18, 1993.

We reference the following memorandums concerning resumption of work for contaminants of concern and statistical comparisons with background for the baseline risk assessments:

- ERD:SRG:11731; October 13, 1993: resumption of Contaminant of Concern selection and statistical comparisons of data to background for OU2.
- ERD:EAD:13759; December 22, 1993: resumption of statistical comparisons of data to background for all operable units.
- EG&G memorandum 94-RF-02971 - SG-179-94; March 14, 1994: methodology for statistical comparisons of data to background.

We have just recently reached agreement with the Environmental Protection Agency (EPA) and the Colorado Department of Health on the methodology for data aggregation and the methodology is attached.

You are directed to revise the schedules for the Operable Units to incorporate the agreed-upon risk assessment methodology by April 25, 1994. In particular, the data aggregation methodology represents "additional work or modifications to work" as per Part 32 of the Interagency Agreement (IAG). As a result, we must determine revised schedules and cost, including the additional scope to incorporate the revised methodology, and make a request to EPA and CDH as per Part 42 (Extensions) of the IAG.

Your April 25, 1994 deliverable to us will include schedule extensions for all Operable Units affected by the stoppage of work, and will specifically denote the time needed (with sufficient rationale) for the "additional work." This is an important distinction because the IAG allows a day-for-day schedule extension (Paragraph 164 of the IAG) for the time the work stoppage was in affect and a schedule extension should easily be granted. However, the time needed for additional work is not as straightforward, and as a result, needs a substantial rationale to support the request for additional time needed.

S. Stiger
ER-SRG-03600

MAR 3 0 1994

If you have any questions please contact Frazer Lockhart at extension 7846.

for Jessie Roberson
Acting Assistant Manager for
Environmental Restoration

cc w/attachment:
A. Rampertaap, EM-453
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S. Grace, ER, RFO
J. Pepe, ER, RFO
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R. Roberts, EG&G

DATA AGGREGATION FOR HEALTH EXPOSURE ASSESSMENT

Specific Data Aggregation Methodology for Rocky Flats

The first consideration of data aggregation is the exposure scenario (land use). Example exposure areas for the Rocky Flats Plant site may be (l) for the industrial/commercial land use scenario, the area of a typical industrial park (2) for the ecological preserve scenario, the area of a preserve, and (3) for the residential land use scenario, the area of a residential neighborhood unless the consideration of a receptor's activity patterns and the mechanisms of toxicity of a particular contaminant indicate that a residential lot size is appropriate.

Following the application of the attached conservative screen (which identifies areas of elevated contaminant concentration which will be the focus of the baseline risk assessment), data must be aggregated for each environmental medium to arrive at the exposure point concentration estimate which will be used in the exposure assessment. Aggregation of all contaminant data, including data below background or detection limits, will be accomplished over the scenario-specific exposure areas within the area of concern identified by the screening process. The recommended data aggregation procedure is as follows:

1) Identify the exposure scenario(s) which will be assessed.

2) Agree on the size of the exposure area for each scenario by considering the receptors, the toxicity of the contaminants of concern (COCs), the exposure pathways, and contaminant variability. Determination of the appropriate exposure area requires an understanding of the mechanisms of toxicity as well as the concepts of exposure. For this reason, experienced risk assessors, toxicologists, and health physicists from all three agencies (EPA, CDH, and DOE) must be consulted.

3) Plot the COC data, including data points below background or detection limit, on a map of the operable unit, delineating the area of concern*.

4) Consult with toxicologists and health physicists from all three agencies (EPA, CDH, and DOE) to place a grid of exposure areas over the area of concern. The grid placement must be approved by the three agency toxicologists and health physicists due to considerations of mechanisms of toxicity. Of course, involvement of other scientific disciplines will also be required.

* Area of Concern = One or several sources** grouped spatially in close proximity.

** Source = Area defined by (1) contaminant levels exceeding background mean plus 2 standard deviations for inorganics and/or (2) detection limits for organics.

5) Risk assessment requires characterization of each exposure area for the site (OSWER Directive 9285.7-09A, April, 1992, p. 55). Generally this requires aggregation of data and a subsequent calculation of risk within each exposure area. This is especially important for heterogeneous data sets. However, at the Rocky Flats site, all parties agree that it is sufficient to calculate risks for only one exposure area per source: the exposure area associated with the highest risk, identified by considering the concentrations of COCs, the affected environmental media, and the number of exposure pathways. If the exposure area associated with the highest risk is not readily identifiable, several exposure areas may be analyzed. **This decision will be made on a case-by-case basis.** In general, not more than one exposure area per source will need to be evaluated unless the exposure pathways differ between exposure areas within the source. Data within the exposure area(s) will be aggregated using the following procedure:

a. Using the complete operable unit data set, determine the statistical distribution for each COC in each environmental media. Present the statistical distribution graphically, along with the data plotted in a histogram which presents the frequency of detection and the magnitude.

b. Use EPA's "Supplemental Guidance to RAGS: Calculating the Concentration Term" to calculate the 95th percent upper confidence limit (95% UCL) of the arithmetic mean over each exposure area for each COC. If the COC data is log-normally distributed, highlight 5 of this guidance document should be used. If the COC data is normally distributed or is determined to be non-parametric, highlight 6 should be used. The guidance states that calculation of the 95% UCL using data sets with fewer than 10 samples per exposure area provides a poor estimate of the mean concentration. Data sets with 20 to 30 samples per exposure area provide fairly consistent estimate of the mean. All parties agree that uncertainties in the estimates of the mean concentrations will be addressed in the uncertainty analysis. **For OUs 2-7, additional field sampling in support of baseline risk assessment must be mutually agreed to by EPA, CDH, and DOE. On a case-by-case basis, with the approval of the regulators, geostatistics may be utilized to incorporate spatial continuity of data.**

6) Use the results of step 5(b) as the exposure point concentration term in the exposure assessment. Consider all COCs in calculating cumulative risks for each exposure area analyzed.

Summary

The above procedure provides the arithmetic average of the exposure concentration that is expected to be contacted over the exposure period within the exposure area associated with the maximum risk within the source. Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is explicitly stated in OSWER Publication 9285.7-081, "Supplemental Guidance to RAGS: Calculating the Concentration Term", the average is used for two reasons:

1. carcinogenic and chronic noncarcinogenic toxicity criteria are based on lifetime average exposures; and

2. average concentration is most representative of the concentration that would be contacted over time if it is assumed that an exposed individual moves randomly across an exposure area.

Considerations of risk due to exposure to a source of contamination will be addressed because all COC data will be considered with respect to how a potential receptor may be exposed, not simply how the contamination is distributed in the environment.

STATE OF COLORADO

COLORADO DEPARTMENT OF HEALTH
Dedicated to protecting and improving the health and environment of the people of Colorado

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Patricia A. Nolan, MD, MPH
Executive Director

March 30, 1994

Mr. Robert L. Duprey, Director
Hazardous Waste Management Division
U.S. Environmental Protection Agency
Region VIII
999 18th Street, Suite 500, 8WM-C
Denver, Colorado 80202-2405

RE: Resolution of Data Aggregation/Baseline Risk Assessment Dispute at the Rocky Flats Plant

Dear Mr. Duprey,

The Colorado Department of Health, Hazardous Materials and Waste Management Division (the Division), hereby concurs with EPA's proposed resolution to the above referenced dispute. However, we do so with the following conditions:

1) The attached language explaining how the "conservative risk screen" will be conducted will be added to your proposal. This language has been reviewed by your staff and DOE staff and is, as far as we know, acceptable to both. As this screen is the first step in the risk evaluation process, we feel it is valuable to add explicit language to this proposal so that consistent correct application of the screen may be achieved.

2) The following changes are made to the text of your proposal as agreed to in staff conference calls on March 24 and 25, 1994:

a) first page, first paragraph, second sentence changed to "Example exposure areas for the Rocky Flats Plant site may be . . ."

b) second page, first paragraph, sixth sentence replaced with "This will be made on will be made on a case-by-case basis."

c) second page, third paragraph, fourth and fifth sentences changed to "The guidance states that . . . fewer than 10 samples per exposure area provides a poor estimate of the mean concentration. Data sets with 20 to 30 samples per

Conservative Risk Screen for Sources[1] at the Rocky Flats Plant

This risk screen will be the first step in the risk assessment process used at Rocky Flats and will be the basis and justification for the type of next steps taken at a given OU (please see attached flow-chart).

The steps in the conservative risk screen are as follows:

1. An entire OU RFI/RI data base will be compared to background using the previously agreed upon Gilbert methodology. (flowchart, block 1)
   - The product of the background comparison will be a list of potential contaminants in the OU. This list will consist of all organic chemicals that exceed detection limit somewhere in the OU, and all inorganic chemicals whose OU population exhibits a significant statistical increase in concentrations compared to the background population either over the whole OU or within some portion of the OU.

2. This list of potential contaminants will be used as the basis for the "nature and extent" evaluation for each OU. Within this evaluation, source areas will be delineated. For organic chemicals on the list, the delineation criteria will be the detection limit; for inorganic chemicals on the list, the delineation criteria will be the arithmetic mean of the background data set plus two standard deviations from the arithmetic mean. (flowchart, block 2)
   - It is recognized that each chemical in each medium may have a different spatial extent within a source. These different spatial extents do not affect the implementation of this screen. A "source," however, will be all contamination that can reasonably be tied together based on existing knowledge of the site, contaminant types, concentrations, rates of migration, etc.

3. For each potential contaminant in each medium, a medium-specific "risk based concentration", or RBC, must be calculated. These RBCs should be calculated based on: 1) direct "residential" exposure and intake parameters, 2) direct ingestion, dermal contact, and inhalation pathways only, and 3) assuming a carcinogenic risk of $1X10^{-6}$ and a non-carcinogenic hazard quotient of 1.0. (These RBCs could be calculated once site-wide since they are chemical-specific and not location specific.)

---

[1] Source = Area defined by 1) contaminant levels exceeding background mean plus 2 standard deviations for inorganics and/or 2) detection limits for organics

4. For each source delineated in #2 above, it is necessary to determine the maximum contaminant levels for each potential contaminant in each affected medium.

5. Once the maximum contaminant levels have been determined, each media/contaminant-specific maximum should be divided by its respective RBC. These maximum/RBC ratios for each contaminant should then be summed for each medium and then across all affected media in a source. Those sources where the ratio sum is less than 1.0 have a risk less than 1X10^{-6} and/or a hazard quotient less than 1.0. Those sources where the ratio sum is greater than 1.0 have a risk greater than 1X10^{-6} and/or a hazard quotient greater than 1.0. (flowchart, block 3)

6. For sources where the ratio sum was less than 1.0, DOE would pursue a "no further action" decision, pending an ARAR analysis (flowchart, block 4). For sources that have a ratio sum greater than 100, DOE would pursue a "voluntary corrective action" but could proceed with a Baseline Risk Assessment (BRA) at their discretion (flowchart, block 5). For sources where the ratio sum was between 1.0 and 100, DOE would pursue a BRA, but could perform a voluntary corrective action at their discretion (flowchart, block 6).

CONSERVATIVE RISK SCREEN

Block 1

Background comparison -- entire OU data set compared to background data set.

Per Gilbert methodology previously agreed upon.

Block 2

Source area delineation -- A source = any area where contaminant levels exceed:

1) detection limits for organic constituents, and
2) arithmetic background mean plus two std dev. for inorganic constituents.

Per "nature and extent" evaluation.

Block 3

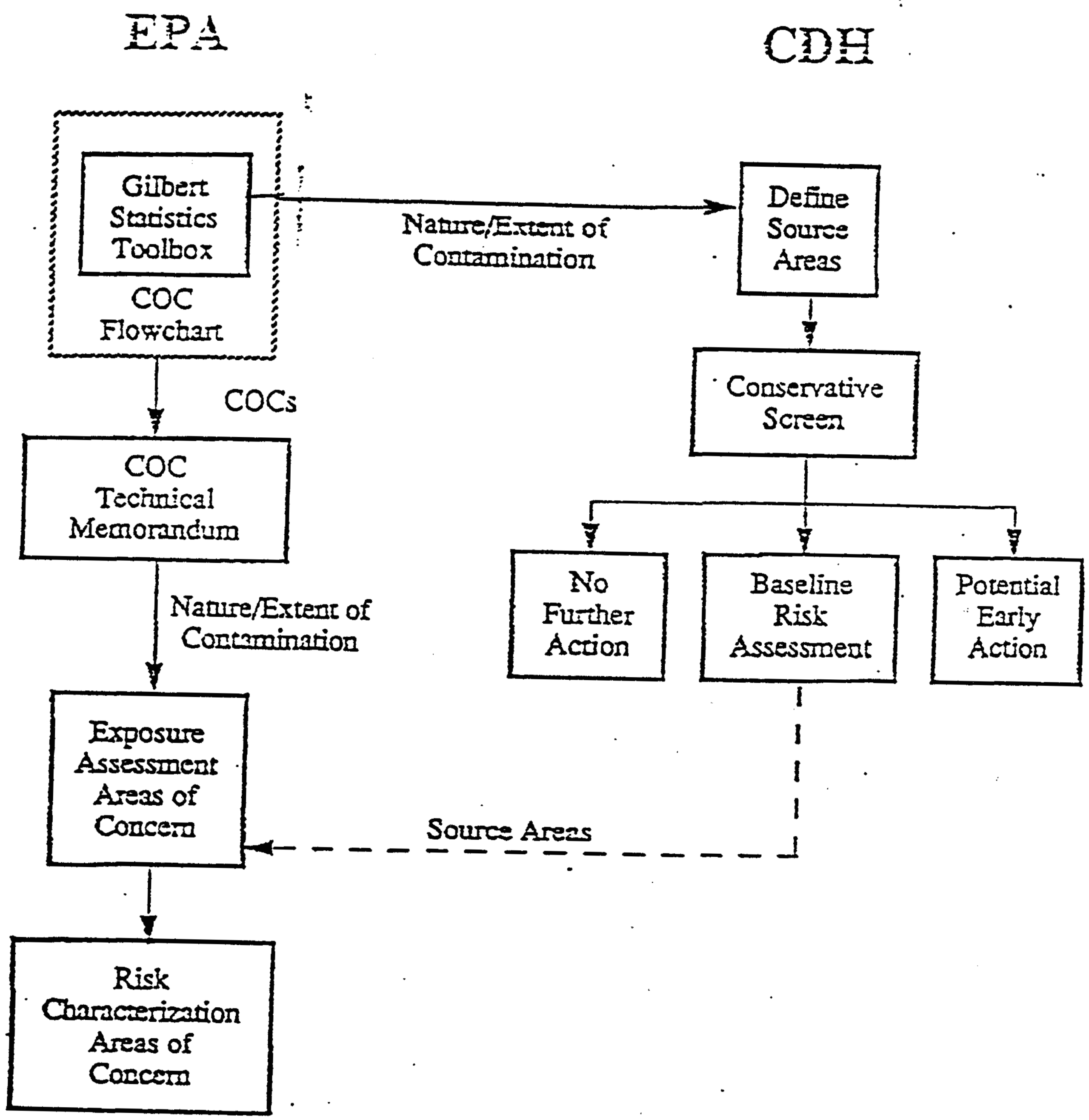
Determine the value for the following ratio for each contaminant in each affected media at a source:

MAXIMUM concentration of each contaminant
/
Media & Contaminant-Specific Risk Based Concentration (RBC)

The values for this ratio should then be summed together appropriately yielding a Ratio Sum for each source.

RBCs based on:
1) direct "residential" exposure parameters, 2) direct ingestion, inhalation, and dermal contact, 3) 10E-6 carcinogenic risk and 1.0 hazard quotient.

- Ration Sum > or = to 100 → DOH to pursue Voluntary Corrective Action (VCA). DOH's option to pursue BRA.
- 1 < Ratio Sum < 100 → DOH to pursue Baseline Risk Assessment (BRA). DOH's option to perform VCA.
- Ratio sum < or = to 1.0 → **Block 4**: DOH to pursue No Further Action (NFA) pending ARAR analysis.


EPA
CDH
Gilbert Statistics Toolbox
COC Flowchart
Nature/Extent of Contamination
Define Source Areas
Conservative Screen
COCs
COC Technical Memorandum
No Further Action
Baseline Risk Assessment
Potential Early Action
Nature/Extent of Contamination
Exposure Assessment Areas of Concern
Source Areas
Risk Characterization Areas of Concern

CDH CONSERVATIVE SCREEN STEP 1

FOR EACH OPERABLE UNIT,
DEFINE THE <u>POTENTIAL CONTAMINANTS</u>

1. INORGANIC CONSTITUENTS SIGNIFICANTLY GREATER THAN BACKGROUND (*GILBERT APPROACH*)

2. ORGANIC CONSTITUENTS GREATER THAN DETECTION LIMIT

CDH CONSERVATIVE SCREEN STEP 2

IDENTIFY SOURCES

1. <u>INORGANIC SOURCE AREA</u> IS DEFINED BY ALL CONTAMINATION ABOVE ARITHMETIC MEAN PLUS 2 STANDARD DEVIATIONS OF BACKGROUND POPULATION

2. <u>ORGANIC SOURCE AREA</u> IS DEFINED BY ALL CONTAMINATION ABOVE DETECTION LIMIT

HOW ARE OVERLAPPING SOURCES HANDLED?

"A SOURCE WILL BE ALL CONTAMINATION THAN CAN REASONABLY BE TIED TOGETHER BASED ON EXISTING KNOWLEDGE OF THE SITE, CONTAMINATION TYPES, CONCENTRATIONS, RATES OF MIGRATION, ETC."

CDH CONSERVATIVE SCREEN STEP 3

CALCULATE A <u>RISK BASED CONCENTRATION</u> FOR EACH POTENTIAL CONTAMINANT IN EACH MEDIUM. USE THE FOLLOWING ASSUMPTIONS:

RESIDENTIAL LAND USE

INGESTION, INHALATION, EXPOSURE PATHWAYS

CARCINOGENIC RISK LEVEL SET AT 1×10^{-6}

NONCARCINOGENIC HAZARD QUOTIENT SET AT 1.0

CDH CONSERVATIVE SCREEN STEP 4

FOR EACH SOURCE AREA IDENTIFIED IN STEP 2, CALCULATE THE RATIO:

$$\frac{(\text{MAXIMUM DETECTED LEVEL OF CONTAMINANT}_i)}{(\text{RISK BASED CONCENTRATION OF CONTAMINANT}_i)}$$

SUM THIS RATIO OVER ALL CONTAMINANTS (i= 1 to N) ; AND OVER ALL MEDIA WITHIN A SOURCE AREA

CDH CONSERVATIVE SCREEN DECISION CRITERIA:

IF ***RATIO SUM*** $\geq$ ***100,*** DOE MAY CONDUCT A ***VOLUNTARY CORRECTIVE ACTION***

IF *1* < ***RATIO SUM*** < ***100,*** DOE MUST CONDUCT A ***BASELINE RISK ASSESSMENT*** IN ACCORDANCE WITH THE RISK ASSESSMENT GUIDANCE FOR SUPERFUND

IF ***RATIO SUM*** $\leq$ ***1, NO FURTHER ACTION*** PENDING ARAR ANALYSIS AND DERMAL EXPOSURE EVALUATION

DERMAL EXPOSURE ASSESSMENT CONSIDERATIONS

SOURCES WITH RATIO SUM <1 (CUMULATIVE RISK $< 10^{-6}$), MUST BE FURTHER CONSIDERED AS FOLLOWS:

INCLUDE AN EVALUATION OF DERMAL CONTACT PER EPA GUIDANCE* ON A CHEMICAL SPECIFIC BASIS

* *DERMAL EXPOSURE ASSESSMENT: PRINCIPLES AND APPLICATIONS, EPA/600/8-91/001B*

AREA OF CONCERN

"ONE OR SEVERAL SOURCES GROUPED SPATIALLY IN CLOSE PROXIMITY"

-DEFINED AFTER SOURCE AREAS HAVE BEEN SCREENED BY THE CDH CONSERVATIVE SCREEN-

OUTPUTS OF THE CDH CONSERVATIVE SCREEN:

POTENTIAL EARLY ACTION SOURCE AREAS

NO FURTHER ACTION SOURCE AREAS

AREA OF CONCERN WHICH WILL BE THE FOCUS OF THE SUPERFUND BASELINE RISK ASSESSMENT

Background comparison - entire OU data set compared to background data set.

Per Gilbert Methodology Previously agreed upon.

Source area delineation - A source = any area where contaminant levels exceed:

1) Detection limits for organic constituents, and
2) Plus two std dev. for inorganic constituents.

Per "nature and extent" evaluation.

Determine the value for the following ratio for each contaminant in each affected media at a source:

$$\frac{\text{Maximum concentration of each contaminant}}{\text{Media \& Contaminant - Specific Risk Based Concentration (RBC)}}$$

The values for this ratio should then be summed together appropriately yielding a Ratio Sum for each source.

RBCs based on:
1) Direct "residential" exposure parameters,
2) Direct ingestion inhalation, and dermal contact,
3) 10E-6 carcinogenic risk and 1,0 hazard quotient

Ration Sum > or = to 100

Block 5

DOE to pursue Voluntary Corrective Action (VCA), DOE's option to pursue BRA.

1 < Ration Sum < 100

Bock 6

DOE to pursue Baseline Risk Assessment (BRA). DOE's option to perform VCA.

Ratio sum < or = to 1.0

Block 4

DOE to pursue No Further Action (NFA) pending ARAR analysis.

HUMAN HEALTH BASELINE RISK ASSESSMENT
DATA AGGREGATION

STEP 1: IDENTIFY CONTAMINANTS OF CONCERN (COCs)

STEP 2 : IDENTIFY THE REASONABLE MAXIMUM EXPOSURE SCENARIO(S)

STEP 3: AGREE ON THE SIZE OF THE EXPOSURE AREA BY CONSIDERING

* TOXICITY OF THE COCS
* EXPOSURE PATHWAYS
* DATA VARIABILITY
* RECEPTOR ACTIVITY PATTERNS

DOCUMENT THE AGREEMENT REACHED IN STEP 3 AND OBTAIN CONSENSUS AMONG ALL THREE AGENCIES' RISK ASSESSORS, TOXICOLOGISTS, AND HEALTH PHYSICISTS

HUMAN HEALTH BASELINE RISK ASSESSMENT
DATA AGGREGATION

STEP 4: PLOT ALL DATA FOR THE COCS WHICH ARE WITHIN THE AREA OF CONCERN ON A MAP OF THE OPERABLE UNIT

STEP 5: PLACE A GRID OF THE AGREED UPON EXPOSURE AREA OVER THE AREA OF CONCERN MAP WITH DATA. THIS WILL REQUIRE CONSENSUS AMONG ALL THREE AGENCIES' RISK ASSESSORS, TOXICOLOGISTS, AND HEALTH PHYSICISTS.

HUMAN HEALTH BASELINE RISK ASSESSMENT
DATA AGGREGATION

STEP 6: WITHIN EACH AREA OF CONCERN, IDENTIFY THE EXPOSURE AREA FROM THE GRID WHICH IS ASSOCIATED WITH THE HIGHEST RISK. CONSIDER:

* COC CONCENTRATIONS AND TOXICITY
* CONTAMINATED MEDIA (MULTIPLE OR SINGLE)
* EXPOSURE PATHWAYS

STEP 7: CALCULATE THE 95% UCL OF THE ARITHMETIC MEAN FOR EACH COC OVER THE EXPOSURE AREA . USE EPA'S "SUPPLEMENTAL GUIDANCE TO RAGS: CALCULATING THE CONCENTRATION TERM" AS GUIDANCE.

SUGGESTED REGULATORY AGENCY APPROVAL POINTS

CDH CONSERVATIVE SCREEN:

STEP 2: SOURCE IDENTIFICATION MAP

STEP 4: A LETTER REPORT WHICH INCLUDES:

TABLE OF POTENTIAL CONTAMINANTS, RISK BASED CONCENTRATIONS, AND RATIO FOR EACH SOURCE AREA

DISCUSSION OF DECISION CRITERIA

MAP OF AREA(S) OF CONCERN

SUGGESTED REGULATORY AGENCY APPROVAL POINTS

HHRA DATA AGGREGATION:

STEP 1: COC TECHNICAL MEMORANDUM AS PLANNED

STEP 2: EXPOSURE SCENARIO TECHNICAL MEMORANDUM AS PLANNED

STEP 3: MEETING BETWEEN HEALTH PROFESSIONALS AND RISK ASSESSORS WITH A FOLLOWUP LETTER DOCUMENTING AGREEMENT

STEP 5: MEETING BETWEEN HEALTH PROFESSIONALS AND RISK ASSESSORS RESULTING IN A MAP OF EXPOSURE AREAS AND THE ONE OR SEVERAL CHOSEN TO REPRESENT HIGHEST RISK. MAY REQUIRE MULTIPLE MAPS DEPENDING ON EXTENT OF CONTAMINATED MEDIA

STEPS 6 & 7 BECOME PART OF THE BASELINE RISK ASSESSMENT DELIVERABLE

Conservative Risk Screen for Sources[1] at the Rocky Flats Plant

This risk screen will be the first step in the risk assessment process used at Rocky Flats and will be the basis and justification for the type of next steps taken at a given OU (please see attached flow-chart).

The steps in the conservative risk screen are as follows:

1. An entire OU RFI/RI data base will be compared to background using the previously agreed upon Gilbert methodology. (flowchart, block 1)
   - The product of the background comparison will be a list of potential contaminants in the OU. This list will consist of all organic chemicals that exceed detection limit somewhere in the OU, and all inorganic chemicals whose OU population exhibits a significant statistical increase in concentrations compared to the background population either over the whole OU or within some portion of the OU.

2. This list of potential contaminants will be used as the basis for the "nature and extent" evaluation for each OU. Within this evaluation, source areas will be delineated. For organic chemicals on the list, the delineation criteria will be the detection limit; for inorganic chemicals on the list, the delineation criteria will be the arithmetic mean of the background data set plus two standard deviations from the arithmetic mean. (flowchart, block 2)
   - It is recognized that each chemical in each medium may have a different spatial extent within a source. These different spatial extents do not affect the implementation of this screen. A "source," however, will be all contamination that can reasonably be tied together based on existing knowledge of the site, contaminant types, concentrations, rates of migration, etc.

3. For each potential contaminant in each medium, a medium-specific "risk based concentration", or RBC, must be calculated. These RBCs should be calculated based on: 1) direct "residential" exposure and intake parameters, 2) direct ingestion, dermal contact, and inhalation pathways only, and 3) assuming a carcinogenic risk of $1X10^{-6}$ and a non-carcinogenic hazard quotient of 1.0. (These RBCs could be calculated once site-wide since they are chemical-specific and not location specific.)

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[1] Source = Area defined by 1) contaminant levels exceeding background mean plus 2 standard deviations for inorganics and/or 2) detection limits for organics

4. For each source delineated in #2 above, it is necessary to determine the maximum contaminant levels for each potential contaminant in each affected medium.

5. Once the maximum contaminant levels have been determined, each media/contaminant-specific maximum should be divided by its respective REC. These maximum/REC ratios for each contaminant should then be summed for each medium and then across all affected media in a source. Those sources where the ratio sum is less than 1.0 have a risk less than $1X10^{-6}$ and/or a hazard quotient less than 1.0. Those sources where the ratio sum is greater than 1.0 have a risk greater than $1X10^{-6}$ and/or a hazard quotient greater than 1.0. (flowchart, block 3)

6. For sources where the ratio sum was less than 1.0, DOE would pursue a "no further action" decision, pending an ARAR analysis (flowchart, block 4). For sources that have a ratio sum greater than 100, DOE would pursue a "voluntary corrective action" but could proceed with a Baseline Risk Assessment (BRA) at their discretion (flowchart, block 5). For sources where the ratio sum was between 1.0 and 100, DOE would pursue a BRA, but could perform a voluntary corrective action at their discretion (flowchart, block 6).

Background comparison - entire OU data set compared to background data set.

Per Gilbert Methodology Previously agreed upon.

Source area delineation - A source = any area where contaminant levels exceed:

1) Detection limits for organic constituents, and
2) Plus two std dev. for inorganic constituents.

Per "nature and extent" evaluation.

Determine the value for the following ratio for each contaminant in each affected media at a source:

$$\frac{\text{Maximum concentration of each contaminant}}{\text{Media \& Contaminant - Specific Risk Based Concentration (RBC)}}$$

The values for this ratio should then be summed together appropriately yielding a Ratio Sum for each source.

RBCs based on:
1) Direct "residential" exposure parameters,
2) Direct ingestion inhalation, and dermal contact,
3) 10E-6 carcinogenic risk and 1,0 hazard quotient

Ration Sum > or = to 100

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DOE to pursue Voluntary Corrective Action (VCA), DOE's option to pursue BRA.

1 < Ration Sum < 100

Bock 6

DOE to pursue Baseline Risk Assessment (BRA). DOE's option to perform VCA.

Ratio sum < or = to 1.0

Block 4

DOE to pursue No Further Action (NFA) pending ARAR analysis.

DATA AGGREGATION FOR HUMAN HEALTH EXPOSURE ASSESSMENT

Specific Data Aggregation Methodology for Rocky Flats

The first consideration of data aggregation is the exposure scenario (land use). Example exposure areas for the Rocky Flats Plant site may be (1) for the industrial/commercial land use scenario, the area of a typical industrial park (2) for the ecological preserve scenario, the area of a preserve, and (3) for the residential land use scenario, the area of a residential neighborhood unless the consideration of a receptor's activity patterns and the mechanisms of toxicity of a particular contaminant indicate that a residential lot size is appropriate.

Following the application of the attached conservative screen (which identifies areas of elevated contaminant concentration which will be the focus of the baseline risk assessment), data must be aggregated for each environmental medium to arrive at the exposure point concentration estimate which will be used in the exposure assessment. Aggregation of all contaminant data, including data below background or detection limits, will be accomplished over the scenario-specific exposure areas within the area of concern identified by the screening process. The recommended data aggregation procedure is as follows:

1) Identify the exposure scenario(s) which will be assessed.

2) Agree on the size of the exposure area for each scenario by considering the receptors, the toxicity of the contaminants of concern (COCs), the exposure pathways, and contaminant variability. Determination of the appropriate exposure area requires an understanding of the mechanisms of toxicity as well as the concepts of exposure. For this reason, experienced risk assessors, toxicologists, and health physicists from all three agencies (EPA, CDH, and DOE) must be consulted.

3) Plot the COC data, including data points below background or detection limit, on a map of the operable unit, delineating the area of concern*.

4) Consult with toxicologists and health physicists from all three agencies (EPA, CDH, and DOE) to place a grid of exposure areas over the area of concern. The grid placement must be approved by the three agency toxicologists and health physicists due to considerations of mechanisms of toxicity. Of course, involvement of other scientific disciplines will also be required.

* Area of Concern = One or several sources** grouped spatially in close proximity

** Source = Area defined by 1) contaminant levels exceeding background mean plus 2 standard deviations for inorganics and/or 2) detection limits for organics

5) Risk assessment requires characterization of each exposure area for the site (OSWER Directive 9285.7-09A, April, 1992, p.55). Generally this requires aggregation of data and a subsequent calculation of risk within each exposure area. This is especially important for heterogeneous data sets. However, at the Rocky Flats site, all parties agree that it is sufficient to calculate risks for only one exposure area per source: the exposure area associated with the highest risk, identified by considering the concentrations of COCs, the affected environmental media, and the number of exposure pathways. If the exposure area associated with the highest risk is not readily identifiable, several exposure areas may be analyzed. This decision will be made on a case by case basis. In general, not more than one exposure area per source will need to evaluated unless the exposure pathways differ between exposure areas within the source. Data within the exposure area(s) will be aggregated using the following procedure:

a. Using the complete operable unit data set, determine the statistical distribution for each COC in each environmental media. Present the statistical distribution graphically, along with the data plotted in a histogram which presents the frequency of detection and the magnitude.

b. Use EPA's "Supplemental Guidance to RAGS: Calculating the Concentration Term" to calculate the 95th percent upper confidence limit (95% UCL) of the arithmetic mean over each exposure area for each COC. If the COC data is lognormally distributed, highlight 5 of this guidance document should be used. If the COC data is normally distributed or is determined to be non-parametric, highlight 6 should be used. The guidance states that calculation of the 95% UCL using data sets with fewer than 10 samples per exposure area provides a poor estimate of the mean concentration. Data sets with 20 to 30 samples per exposure area provide fairly consistent estimate of the mean. All parties agree that uncertainties in the estimates of the mean concentrations will be addressed in the uncertainty analysis. For Operable Units 2 through 7, additional field sampling in support of baseline risk assessment must be mutually agreed to by EPA, CDH, and DOE. On a case by case basis, with the approval of the regulators, geostatistics may be utilized to incorporate spatial continuity of data.

6) Use the results of step 5(b) as the exposure point concentration term in the exposure assessment. Consider all COCs in calculating cumulative risks for each exposure area analyzed.

Summary

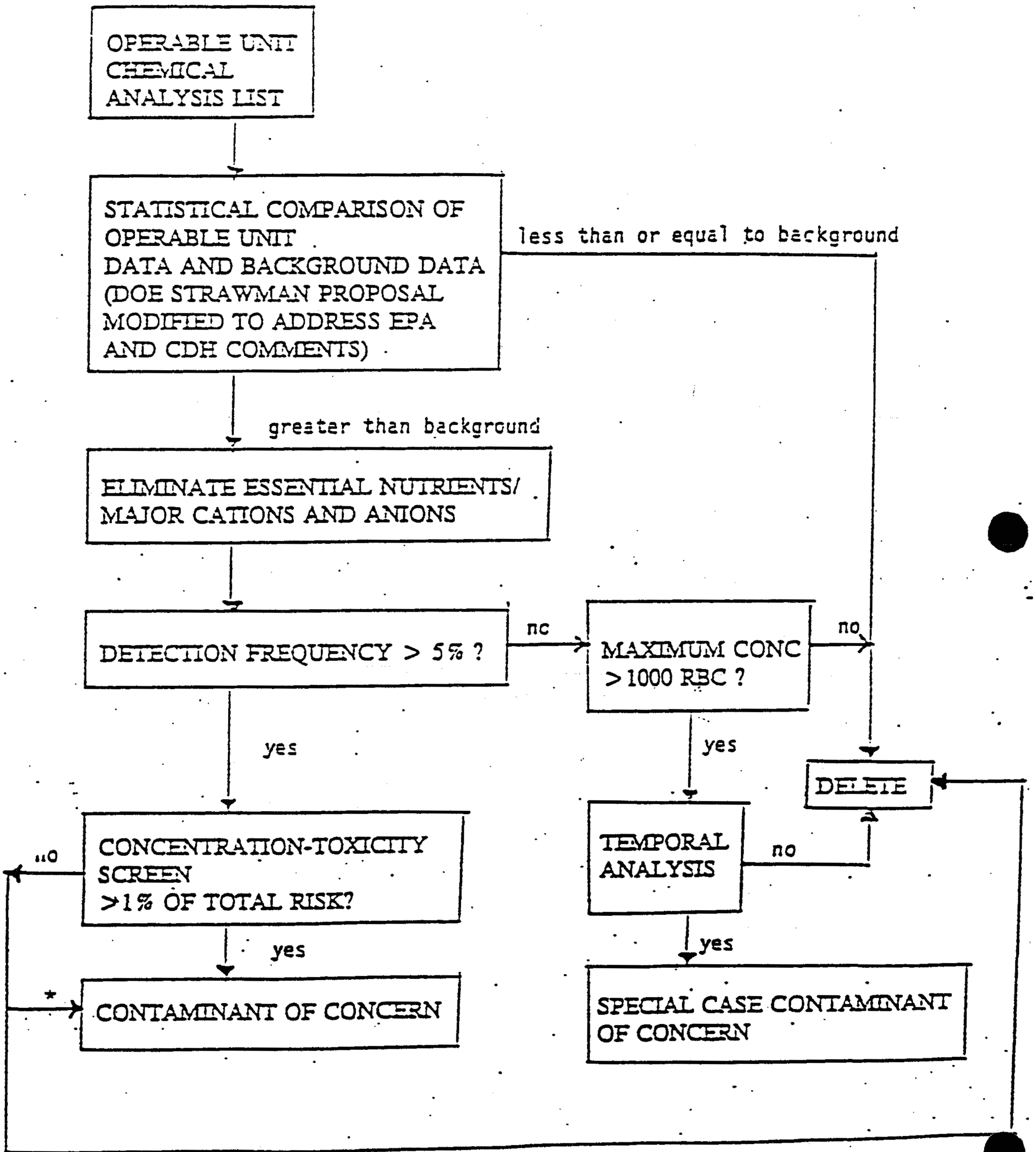
The above procedure provides the arithmetic average of the exposure concentration that is expected to be contacted over the exposure period within the exposure area associated with the maximum risk within the source. Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is explicitly stated in OSWER Publication 9285.7-081, "Supplemental Guidance to RAGS: Calculating the Concentration Term", the average is used for two reasons:

1. carcinogenic and chronic noncarcinogenic toxicity criteria are based on lifetime average exposures; and

2. average concentration is most representative of the concentration that would be contacted over time if it is assumed that an exposed individual moves randomly across an exposure area.

Considerations of risk due to exposure to a source of contamination will be addressed because all COC data will be considered with respect to how a potential receptor may be exposed, not simply how the contamination is distributed in the environment.

CONTAMINANTS OF CONCERN SELECTION PROCESS



* professional judgement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

MAR 24 1994

Ref: 8HWM-FF

Mr. Richard Schassburger
U.S. Department of Energy
Rocky Flats Office
P.O. Box 928
Golden, CO 80402-0928

RE: Operable Unit 3
Comparisons to Background Data

Dear Mr. Schassburger:

Representatives of EPA, CDH, and DOE contractors met on March 10, 1994, to discuss options for comparing the remedial investigation data collected from Mower Reservoir, Standley Lake Reservoir, and Great Western Reservoir to background data. The intent of this letter is to document the agreement reached at this meeting.

EPA and CDH agree that a weight of evidence approach may be used to address the question of whether metals and radionuclides in the reservoirs are above background levels. The evidence considered should include, but may not be limited to the following:

1. A comparison of stream sediment data in the Operable Unit 3 (OU 3) drainages to background concentrations of stream sediments in the Background Geochemical Report. Those constituents above background in the drainages should be considered as potentially above background in the reservoirs.

2. A comparison of reservoir data to appropriate background values taken from the existing scientific literature.

3. A consideration of the results of remedial investigation sediment sampling in the Woman Creek and the Walnut Creek drainages (Operable Unit 5 and Operable Unit 6) to determine potential releases into the off site reservoirs.

We understand that this approach deviates from the standard protocol for making background comparisons at the Rocky Flats site which was recommended by Dr. Richard Gilbert of Battelle Pacific Northwest Laboratories and accepted by all three Interagency Agreement parties in a facilitated process (EPA letter dated October 25, 1993; CDH letter dated

October 13, 1993). The protocol is highly statistically based. A key assumption is that the background data set is representative.

The available data characterizing background concentrations of reservoir sediments is sparse, therefore, a deviation from Dr. Gilbert's approach is warranted in the case of OU 3 reservoir sediments. In fact, we believe that if DOE were to use Dr. Gilbert's approach, the conclusions would be less supportable than a weight of evidence approach.

If there are any questions regarding this issue, please direct them to Bonnie Lavelle of EPA at (303) 294-1067, or Dave Norberry of CDH at (303) 692-3415.

Sincerely,

Martin Hestmark

Martin Hestmark, Manager
Rocky Flats Project

cc: Bob Birk, DOE
Mark Buddy, EG&G
Joe Schieffelin, CDH
Dave Norberry, CDH

NOTICE

All drawings located at the end of the document.

Appendix B

SUMMARY STATISTICS FOR OU 3 DATA AND BENCHMARK DATA

APPENDIX B. SUMMARY STATISTICS FOR OU 3 DATA AND BENCHMARK DATA

Appendix B presents a statistical summary of OU 3 data and benchmark data for sediment, surface water, and groundwater. It should be noted that the summary statistics were developed after data protocols were applied but before the COC selection process. Summary statistics were performed on the Data Analysis table of the OU 3 database (See Appendix A of TM 4 [DOE, 1994b] for description of the Data Analysis table and the OU 3 database). The summary statistics for each analyte by IHSS and type includes: number of detects, number of samples, frequency of detection, minimum and maximum nondetected values, minimum and maximum detected values, arithmetic mean, standard deviation, and coefficient of variation.

Following, is a list of Summary Statistics of OU 3 data with a comparison to benchmark data. The tables are grouped by media, IHSS, and type (lake or creek):

Table B-1	Summary Statistics for OU 3 Surface Sediments; Comparison to Benchmark Data
Table B-2	Summary Statistics for OU 3 Subsurface Sediments; Comparison to Benchmark Data
Table B-3	Summary Statistics for OU 3 Surface Water; Comparison to Benchmark Data
Table B-4	Summary Statistics for OU 3 Groundwater; Comparison to Benchmark Data

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
METALS														
ALUMINUM	mg/kg	BGCR	CREEK	B	59	59	1.00			549.00	25200.00	5887.610	4912.73	
ALUMINUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			2220.00	13800.00	8233.750	3848.05	0.47
ALUMINUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			1900.00	33200.00	8030.714	7958.47	0.99
ALUMINUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			9110.00	15200.00	11227.500	2718.15	0.24
ALUMINUM	mg/kg	LOWRY	CREEK	B							32100.00	13959.330	7080.88	
ALUMINUM	mg/kg	CC-BM	LAKE	B						96700.00	96700.00			
ALUMINUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			4530.00	20800.00	10910.833	4212.31	0.39
ALUMINUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			852.00	23500.00	9834.814	6623.01	0.67
ALUMINUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			7480.00	18300.00	14370.000	3096.10	0.22
ANTIMONY	mg/kg	BGCR	CREEK	B						0.80	12.40	3.290	2.73	
ANTIMONY	mg/kg	IHSS 200	CREEK	S	5	8	0.63	1.80	2.40	6.50	11.30	6.469	3.84	0.59
ANTIMONY	mg/kg	IHSS 201	CREEK	S	1	13	0.08	2.30	6.70	6.40	6.40	3.708	1.60	0.43
ANTIMONY	mg/kg	IHSS 202	CREEK	S	1	4	0.25	5.25	6.15	16.50	16.50	8.300	5.48	0.66
ANTIMONY	mg/kg	IHSS 200	LAKE	S	6	15	0.40	2.40	3.10	5.90	13.20	5.017	3.49	0.70
ANTIMONY	mg/kg	IHSS 201	LAKE	S	3	21	0.14	1.75	7.55	4.90	6.90	3.181	1.72	0.54
ANTIMONY	mg/kg	IHSS 202	LAKE	S	1	6	0.17	4.60	44.40	17.30	17.30	14.858	15.23	1.03
ARSENIC	mg/kg	BGCR	CREEK	B	53	59	0.90			0.20	17.30	2.410	2.45	
ARSENIC	mg/kg	IHSS 200	CREEK	S	8	8	1.00			3.70	9.40	5.313	1.85	0.35
ARSENIC	mg/kg	IHSS 201	CREEK	S	14	14	1.00			2.20	7.80	4.764	1.53	0.32
ARSENIC	mg/kg	IHSS 202	CREEK	S	4	4	1.00			3.00	6.80	4.875	1.56	0.32
ARSENIC	mg/kg	LOWRY	CREEK	B							16.50	4.810	3.95	
ARSENIC	mg/kg	CC-BM	LAKE	B						5.57	5.57			

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
ARSENIC	mg/kg	IHSS 200	LAKE	S	36	36	1.00			2.60	9.40	4.906	1.46	0.30
ARSENIC	mg/kg	IHSS 201	LAKE	S	43	43	1.00			1.20	17.70	6.963	4.34	0.62
ARSENIC	mg/kg	IHSS 202	LAKE	S	15	15	1.00			2.20	10.40	5.147	1.96	0.38
ARSENIC	mg/kg	RMNP-BM (L. Husted)	LAKE	B								2.500	0.20	
ARSENIC	mg/kg	RMNP-BM (L. Louise)	LAKE	B								2.500	0.30	
ARSENIC	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								8.400	0.20	
ARSENIC	mg/kg	RMNP-BM (The Loch)	LAKE	B								1.400	0.20	
BARIUM	mg/kg	BGCR	CREEK	B	57	57	1.00			10.60	244.00	77.910	56.38	
BARIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			78.60	243.00	136.713	50.49	0.37
BARIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			85.00	329.00	150.714	59.75	0.40
BARIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			81.50	296.00	150.950	100.64	0.67
BARIUM	mg/kg	LOWRY	CREEK	B							440.00	220.640	76.59	
BARIUM	mg/kg	CC-BM	LAKE	B						591.00	591.00			
BARIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			38.20	190.00	128.989	38.71	0.30
BARIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			10.80	196.00	101.372	56.65	0.56
BARIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			103.00	250.00	173.000	47.92	0.28
BERYLLIUM	mg/kg	BGCR	CREEK	B	27	57	0.47			1.50	1.30	0.660	1.69	
BERYLLIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			0.24	1.60	0.851	0.38	0.45
BERYLLIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			0.22	1.50	0.577	0.31	0.54
BERYLLIUM	mg/kg	IHSS 202	CREEK	S	3	3	1.00			0.41	1.40	0.783	0.54	0.69
BERYLLIUM	mg/kg	LOWRY	CREEK	B							2.10	1.040	0.48	
BERYLLIUM	mg/kg	CC-BM	LAKE	B						4.03	4.03			
BERYLLIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			0.37	1.40	0.850	0.27	0.31
BERYLLIUM	mg/kg	IHSS 201	LAKE	S	39	43	0.91	0.06	0.07	0.15	1.60	0.700	0.47	0.67
BERYLLIUM	mg/kg	IHSS 202	LAKE	S	13	14	0.93	1.00	1.00	0.54	1.50	1.061	0.27	0.25

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SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
BERYLLIUM	mg/kg	RMNP-BM (L. Husted)	LAKE	B								3.900	1.00	
BERYLLIUM	mg/kg	RMNP-BM (L. Louise)	LAKE	B								5.000	3.00	
BERYLLIUM	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								9.300	1.10	
BERYLLIUM	mg/kg	RMNP-BM (The Loch)	LAKE	B								7.400	1.30	
CADMIUM	mg/kg	BGCR	CREEK	B	6	51	0.12			0.13	1.30	0.540	0.36	
CADMIUM	mg/kg	IHSS 200	CREEK	S	3	8	0.38	0.22	0.31	0.41	1.60	0.590	0.57	0.96
CADMIUM	mg/kg	IHSS 201	CREEK	S	7	14	0.50	0.21	0.75	0.77	6.30	1.802	1.79	0.99
CADMIUM	mg/kg	IHSS 202	CREEK	S		4		0.47	0.95			0.593	0.24	0.40
CADMIUM	mg/kg	LOWRY	CREEK	B							3.80	1.040	0.99	
CADMIUM	mg/kg	CC-BM	LAKE	B						0.05	0.05			
CADMIUM	mg/kg	IHSS 200	LAKE	S	14	36	0.39	0.20	0.45	0.58	1.70	0.568	0.43	0.76
CADMIUM	mg/kg	IHSS 201	LAKE	S	22	37	0.59	0.18	0.30	0.54	5.00	1.719	1.60	0.93
CADMIUM	mg/kg	IHSS 202	LAKE	S		8		0.35	3.95			0.986	1.22	1.23
CADMIUM	mg/kg	RMNP-BM (L. Husted)	LAKE	B								0.700	0.04	
CADMIUM	mg/kg	RMNP-BM (L. Louise)	LAKE	B								0.500	0.30	
CADMIUM	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								0.340	0.03	
CADMIUM	mg/kg	RMNP-BM (The Loch)	LAKE	B								0.320	0.05	
CALCIUM	mg/kg	BGCR	CREEK	B	58	59	0.98			93.50	17100.00	3658.240	4663.60	
CALCIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			1570.00	18300.00	7762.500	5522.52	0.71
CALCIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			911.00	75000.00	13887.214	20983.28	1.51
CALCIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			6480.00	59400.00	22077.500	25024.06	1.13
CALCIUM	mg/kg	CC-BM	LAKE	B						12.00	12.00			
CALCIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			3260.00	33900.00	7465.000	5909.62	0.79
CALCIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			427.00	90100.00	8091.930	14021.39	1.73

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SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
CALCIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			7050.00	42000.00	15209.333	8374.69	0.55
CALCIUM	mg/kg	RMNP-BM (L. Husted)	LAKE	B								26.000	1.00	
CALCIUM	mg/kg	RMNP-BM (L. Louise)	LAKE	B								34.100	0.10	
CALCIUM	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								54.000	5.00	
CALCIUM	mg/kg	RMNP-BM (The Loch)	LAKE	B								47.000	6.00	
CESIUM	mg/kg	BGCR	CREEK	B	10	56	0.18				157.00	69.290	63.88	
CESIUM	mg/kg	IHSS 200	CREEK	S		8		44.95	66.50			53.381	8.03	0.15
CESIUM	mg/kg	IHSS 201	CREEK	S	3	14	0.21	6.95	104.50	3.10	19.90	40.850	32.84	0.80
CESIUM	mg/kg	IHSS 202	CREEK	S	3	4	0.75	126.50	126.50	1.80	2.00	33.050	62.30	1.89
CESIUM	mg/kg	IHSS 200	LAKE	S	9	36	0.25	6.90	78.50	14.10	29.70	36.006	26.06	0.72
CESIUM	mg/kg	IHSS 201	LAKE	S		37		5.80	71.00			26.968	25.39	0.94
CESIUM	mg/kg	IHSS 202	LAKE	S	1	9	0.11	1.25	15.75	69.80	69.80	14.744	21.57	1.46
CHROMIUM	mg/kg	BGCR	CREEK	B	47	59	0.80			0.48	29.70	8.130	7.42	
CHROMIUM	mg/kg	IHSS 200	CREEK	S	6	8	0.75	0.19	0.27	2.40	12.70	4.894	4.61	0.94
CHROMIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			2.70	31.90	8.807	7.14	0.81
CHROMIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			6.80	17.00	12.650	5.12	0.41
CHROMIUM	mg/kg	LOWRY	CREEK	B							22.90	12.350	5.54	
CHROMIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			3.70	19.80	10.947	3.79	0.35
CHROMIUM	mg/kg	IHSS 201	LAKE	S	40	43	0.93	0.22	0.24	0.89	21.40	9.897	6.91	0.70
CHROMIUM	mg/kg	IHSS 202	LAKE	S	14	15	0.93	4.40	4.40	5.10	22.10	14.800	5.14	0.35
COBALT	mg/kg	BGCR	CREEK	B	43	59	0.23			0.30	15.00	5.040	3.29	
COBALT	mg/kg	IHSS 200	CREEK	S	8	8	1.00			4.50	23.30	11.250	6.00	0.53
COBALT	mg/kg	IHSS 201	CREEK	S	14	14	1.00			2.90	10.90	7.900	2.20	0.28
COBALT	mg/kg	IHSS 202	CREEK	S	4	4	1.00			6.30	9.60	7.825	1.36	0.17
COBALT	mg/kg	LOWRY	CREEK	B							14.00	9.200	2.86	

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SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
COBALT	mg/kg	CC-BM	LAKE	B						21.30	21.30			
COBALT	mg/kg	IHSS 200	LAKE	S	36	36	1.00			3.50	13.50	8.664	2.03	0.23
COBALT	mg/kg	IHSS 201	LAKE	S	43	43	1.00			1.30	13.20	7.049	3.53	0.50
COBALT	mg/kg	IHSS 202	LAKE	S	14	15	0.93	5.85	5.85	4.40	15.30	8.357	2.55	0.31
COPPER	mg/kg	BGCR	CREEK	B	43	59	0.73			10.15	36.70	10.150	7.86	
COPPER	mg/kg	IHSS 200	CREEK	S	8	8	1.00			8.90	37.50	20.525	8.20	0.40
COPPER	mg/kg	IHSS 201	CREEK	S	14	14	1.00			12.90	52.30	30.293	13.27	0.44
COPPER	mg/kg	IHSS 202	CREEK	S	4	4	1.00			7.30	18.20	11.125	4.83	0.43
COPPER	mg/kg	LOWRY	CREEK	B							48.30	17.580	8.98	
COPPER	mg/kg	CC-BM	LAKE	B						43.40	43.40			
COPPER	mg/kg	IHSS 200	LAKE	S	36	36	1.00			8.10	129.00	48.567	37.57	0.77
COPPER	mg/kg	IHSS 201	LAKE	S	43	43	1.00			1.20	183.00	67.919	64.90	0.96
COPPER	mg/kg	IHSS 202	LAKE	S	14	15	0.93	11.65	11.65	11.10	50.10	26.797	12.47	0.47
CYANIDE	mg/kg	IHSS 201	CREEK	S		3		0.330	0.445			0.382	0.058	
CYANIDE	mg/kg	IHSS 201	LAKE	S		21		0.305	1.250			0.440	0.199	
CYANIDE	mg/kg	IHSS 200	LAKE	S		21		0.70	0.800			0.526	0.150	
CYANIDE	mg/kg	IHSS 202	LAKE	S		6		0.600	0.90			0.767	0.121	
IRON	mg/kg	BGCR	CREEK	B	59	59	1.00			1040.00	31400.00	8852.630	6263.19	
IRON	mg/kg	IHSS 200	CREEK	S	8	8	1.00			9430.00	51700.00	25816.250	14443.51	0.56
IRON	mg/kg	IHSS 201	CREEK	S	14	14	1.00			5670.00	26600.00	15397.857	5232.17	0.34
IRON	mg/kg	IHSS 202	CREEK	S	4	4	1.00			14300.00	27000.00	19200.000	5832.67	0.30
IRON	mg/kg	CC-BM	LAKE	B						49700.00	49700.00			
IRON	mg/kg	IHSS 200	LAKE	S	36	36	1.00			4670.00	53900.00	16888.333	8712.93	0.52
IRON	mg/kg	IHSS 201	LAKE	S	43	43	1.00			3100.00	28300.00	14866.512	6835.61	0.46
IRON	mg/kg	IHSS 202	LAKE	S	15	15	1.00			10800.00	48000.00	19886.667	8631.99	0.43

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SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
IRON	mg/kg	RMNP-BM (L. Husted)	LAKE	B								1600.000	40.00	
IRON	mg/kg	RMNP-BM (L. Louise)	LAKE	B								2400.000	100.00	
IRON	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								6200.000	900.00	
IRON	mg/kg	RMNP-BM (The Loch)	LAKE	B								2300.000	300.00	
LEAD	mg/kg	BGCR	CREEK	B	59	59	1.00			2.10	244.00	22.020	36.79	
LEAD	mg/kg	IHSS 200	CREEK	S	8	8	1.00			5.30	36.20	18.513	9.36	0.51
LEAD	mg/kg	IHSS 201	CREEK	S	14	14	1.00			17.20	91.40	38.450	21.06	0.55
LEAD	mg/kg	IHSS 202	CREEK	S	4	4	1.00			12.30	21.60	16.775	3.81	0.23
LEAD	mg/kg	LOWRY	CREEK	B							380.00	28.290	66.79	
LEAD	mg/kg	CC-BM	LAKE	B						55.00	55.00			
LEAD	mg/kg	IHSS 200	LAKE	S	36	36	1.00			13.00	88.20	31.372	18.61	0.59
LEAD	mg/kg	IHSS 201	LAKE	S	43	43	1.00			2.90	317.00	63.747	67.11	1.05
LEAD	mg/kg	IHSS 202	LAKE	S	15	15	1.00			14.50	40.80	29.987	7.75	0.26
LEAD	mg/kg	RMNP-BM (L. Husted)	LAKE	B										
LEAD	mg/kg	RMNP-BM (L. Louise)	LAKE	B								43.000	0.00	
LEAD	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								26.000	2.00	
LEAD	mg/kg	RMNP-BM (The Loch)	LAKE	B								14.000	2.00	
LITHIUM	mg/kg	BGCR	CREEK	B	41	57	0.72			1.15	20.20	7.480	5.26	
LITHIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			1.80	11.50	6.650	3.19	0.48
LITHIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			2.10	34.60	8.207	8.31	1.01
LITHIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			7.10	16.20	9.475	4.49	0.47
LITHIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			3.10	17.60	8.958	3.09	0.34
LITHIUM	mg/kg	IHSS 201	LAKE	S	42	43	0.98	0.24	0.24	0.53	17.10	7.529	4.84	0.64
LITHIUM	mg/kg	IHSS 202	LAKE	S	14	15	0.93	7.95	7.95	7.00	13.90	11.017	2.37	0.22

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SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
MAGNESIUM	mg/kg	BGCR	CREEK	B	54	59	0.92			125.50	5850.00	1473.770	1252.57	
MAGNESIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			684.00	4180.00	2305.500	1039.53	0.45
MAGNESIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			595.00	9480.00	2531.071	2234.40	0.88
MAGNESIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			2270.00	4460.00	2887.500	1053.58	0.36
MAGNESIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			1280.00	5140.00	2871.667	791.80	0.28
MAGNESIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			197.00	6430.00	2683.442	1632.54	0.61
MAGNESIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			2480.00	5040.00	4064.000	662.17	0.16
MANGANESE	mg/kg	BGCR	CREEK	B	58	59	0.98			9.00	1280.00	227.820	215.48	
MANGANESE	mg/kg	IHSS 200	CREEK	S	8	8	1.00			155.00	1550.00	684.000	526.56	0.77
MANGANESE	mg/kg	IHSS 201	CREEK	S	14	14	1.00			83.50	4450.00	1706.179	1447.03	0.85
MANGANESE	mg/kg	IHSS 202	CREEK	S	4	4	1.00			238.00	1170.00	548.000	423.63	0.77
MANGANESE	mg/kg	LOWRY	CREEK	B							1560.00	605.100	281.36	
MANGANESE	mg/kg	CC-BM	LAKE	B						739.00	739.00			
MANGANESE	mg/kg	IHSS 200	LAKE	S	36	36	1.00			40.50	813.00	425.914	211.90	0.50
MANGANESE	mg/kg	IHSS 201	LAKE	S	43	43	1.00			89.60	2080.00	595.379	592.16	0.99
MANGANESE	mg/kg	IHSS 202	LAKE	S	15	15	1.00			148.00	925.00	297.800	194.93	0.65
MERCURY	mg/kg	BGCR	CREEK	B	2	49	0.04			0.01	0.05	0.080	0.06	
MERCURY	mg/kg	IHSS 200	CREEK	S		8		0.03	0.07			0.046	0.01	0.25
MERCURY	mg/kg	IHSS 201	CREEK	S	3	14	0.21	0.03	0.08	0.08	0.14	0.061	0.03	0.51
MERCURY	mg/kg	IHSS 202	CREEK	S		4		0.03	0.11			0.045	0.04	0.89
MERCURY	mg/kg	LOWRY	CREEK	B							0.29	0.080	0.06	
MERCURY	mg/kg	CC-BM	LAKE	B						0.06	0.06			
MERCURY	mg/kg	IHSS 200	LAKE	S	4	36	0.11	0.03	0.08	0.10	0.20	0.063	0.03	0.51
MERCURY	mg/kg	IHSS 201	LAKE	S	18	42	0.43	0.00	0.10	0.08	0.60	0.116	0.12	1.06
MERCURY	mg/kg	IHSS 202	LAKE	S	1	8	0.13	0.04	0.23	0.10	0.10	0.081	0.06	0.77
MERCURY	mg/kg	RMNP-BM (L. Husted)	LAKE	B								0.030	0.01	
MERCURY	mg/kg	RMNP-BM (L. Louise)	LAKE	B								0.065	0.01	
MERCURY	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								0.050	0.00	

Table B-1

**SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA**

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
MERCURY	mg/kg	RMNP-BM (The Loch)	LAKE	B								0.040	0.01	
MOLYBDENUM	mg/kg	BGCR	CREEK	B	16	58	0.28			0.33	9.60	4.470	5.23	
MOLYBDENUM	mg/kg	IHSS 200	CREEK	S	6	8	0.75	0.80	0.80	3.60	17.90	7.838	6.30	0.80
MOLYBDENUM	mg/kg	IHSS 201	CREEK	S	6	14	0.43	0.35	2.30	1.60	6.70	2.379	1.87	0.78
MOLYBDENUM	mg/kg	IHSS 202	CREEK	S		4		1.80	2.10			1.900	0.14	0.07
MOLYBDENUM	mg/kg	CC-BM	LAKE	B						22.00	22.00			
MOLYBDENUM	mg/kg	IHSS 200	LAKE	S	23	36	0.64	0.24	0.85	0.58	13.30	3.077	3.47	1.13
MOLYBDENUM	mg/kg	IHSS 201	LAKE	S	20	37	0.54	0.20	1.25	0.69	7.70	1.910	2.17	1.14
MOLYBDENUM	mg/kg	IHSS 202	LAKE	S		8		0.42	15.40			3.389	5.02	1.48
NICKEL	mg/kg	BGCR	CREEK	B	39	57	0.68			0.65	25.60	6.750	5.38	
NICKEL	mg/kg	IHSS 200	CREEK	S	8	8	1.00			10.00	72.70	25.200	20.31	0.81
NICKEL	mg/kg	IHSS 201	CREEK	S	13	14	0.93	3.15	3.15	8.60	22.60	14.811	5.53	0.37
NICKEL	mg/kg	IHSS 202	CREEK	S	3	4	0.75	3.55	3.55	14.90	16.90	12.588	6.09	0.48
NICKEL	mg/kg	LOWRY	CREEK	B							131.00	15.450	22.29	
NICKEL	mg/kg	CC-BM	LAKE	B						26.20	26.20			
NICKEL	mg/kg	IHSS 200	LAKE	S	36	36	1.00			5.70	22.70	15.725	3.96	0.25
NICKEL	mg/kg	IHSS 201	LAKE	S	40	43	0.93	1.20	1.35	3.40	23.70	12.338	6.64	0.54
NICKEL	mg/kg	IHSS 202	LAKE	S	12	15	0.80	4.85	29.90	10.50	29.20	17.087	6.70	0.39
NICKEL	mg/kg	RMNP-BM (L. Husted)	LAKE	B								9.600	0.20	
NICKEL	mg/kg	RMNP-BM (L. Louise)	LAKE	B								10.000	0.00	
NICKEL	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								12.300	0.60	
NICKEL	mg/kg	RMNP-BM (The Loch)	LAKE	B								18.000	2.00	
POTASSIUM	mg/kg	BGCR	CREEK	B	43	58	0.24			57.00	3770.00	835.340	749.42	
POTASSIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			548.00	2090.00	1210.375	579.40	0.48
POTASSIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			549.00	8390.00	1794.857	1993.05	1.11

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
POTASSIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			1210.00	2760.00	1745.000	691.40	0.40
POTASSIUM	mg/kg	CC-BM	LAKE	B						15100.00	15100.00			
POTASSIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			402.00	2700.00	1573.750	598.93	0.38
POTASSIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			183.00	3630.00	1734.512	1138.91	0.66
POTASSIUM	mg/kg	IHSS 202	LAKE	S	14	15	0.93	2755.00	2755.00	1370.00	3450.00	2777.000	639.00	0.23
SELENIUM	mg/kg	BGCR	CREEK	B	13	58	0.22			0.10	2.90	0.420		
SELENIUM	mg/kg	IHSS 200	CREEK	S	6	8	0.75	0.11	0.11	0.44	0.77	0.487	0.26	0.53
SELENIUM	mg/kg	IHSS 201	CREEK	S	3	14	0.21	0.10	0.60	1.50	2.20	0.598	0.74	1.24
SELENIUM	mg/kg	IHSS 202	CREEK	S		4		0.11	0.28			0.190	0.07	0.36
SELENIUM	mg/kg	CC-BM	LAKE	B						1.10	1.10			
SELENIUM	mg/kg	IHSS 200	LAKE	S	13	22	0.59	0.10	1.10	0.24	4.00	0.888	1.04	1.17
SELENIUM	mg/kg	IHSS 201	LAKE	S	9	32	0.28	0.10	3.55	0.18	4.50	0.892	1.02	1.15
SELENIUM	mg/kg	IHSS 202	LAKE	S	3	11	0.27	0.15	1.60	1.90	5.70	1.723	2.00	1.16
SELENIUM	mg/kg	RMNP-BM (L. Husted)	LAKE	B								1.800	0.10	
SELENIUM	mg/kg	RMNP-BM (L. Louise)	LAKE	B								1.200	0.10	
SELENIUM	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								1.800	0.40	
SELENIUM	mg/kg	RMNP-BM (The Loch)	LAKE	B								1.100	0.30	
SILICON	mg/kg	BGCR	CREEK	B	19	19	1.00				1450.00	331.530	362.31	
SILICON	mg/kg	IHSS 200	CREEK	S	8	8	1.00			128.00	1020.00	459.125	365.62	0.80
SILICON	mg/kg	IHSS 201	CREEK	S	8	8	1.00			281.00	3290.00	1167.500	937.25	0.80
SILICON	mg/kg	IHSS 202	CREEK	S	1	1	1.00			412.00	412.00	412.000		
SILICON	mg/kg	IHSS 200	LAKE	S	15	15	1.00			115.00	650.00	237.667	125.31	0.53
SILICON	mg/kg	IHSS 201	LAKE	S	13	13	1.00			82.00	396.00	197.308	79.13	0.40
SILVER	mg/kg	BGCR	CREEK	B	2	54	0.04			0.20	3.40	0.660	0.52	
SILVER	mg/kg	IHSS 200	CREEK	S	7	8	0.88	0.26	0.26	1.20	4.00	2.382	1.35	0.57

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
SILVER	mg/kg	IHSS 201	CREEK	S	8	14	0.57	0.25	0.75	0.79	2.10	0.942	0.58	0.62
SILVER	mg/kg	IHSS 202	CREEK	S	1	4	0.25	0.43	0.43	1.90	1.90	0.796	0.74	0.92
SILVER	mg/kg	CC-BM	LAKE	B						0.05	0.05			
SILVER	mg/kg	IHSS 200	LAKE	S	28	36	0.78	0.26	0.95	1.10	6.00	1.917	1.13	0.59
SILVER	mg/kg	IHSS 201	LAKE	S	31	35	0.89	0.23	0.50	0.48	7.70	1.995	1.77	0.89
SILVER	mg/kg	IHSS 202	LAKE	S	2	8	0.25	0.60	3.60	1.50	1.90	1.400	0.99	0.71
SODIUM	mg/kg	BGCR	CREEK	B	47	59	0.80			162.00	637.00	161.470	136.80	
SODIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			57.70	2490.00	535.588	811.75	1.52
SODIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			51.50	1610.00	286.107	412.13	1.44
SODIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			193.00	533.00	291.500	161.71	0.55
SODIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			43.20	997.00	268.389	240.31	0.90
SODIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			26.00	509.00	138.735	96.81	0.70
SODIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			171.00	1080.00	369.333	210.39	0.57
STRONTIUM	mg/kg	BGCR	CREEK	B	48	58	0.83			2.80	421.00	36.380	59.87	
STRONTIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			15.00	91.30	55.375	27.23	0.49
STRONTIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			18.30	227.00	67.286	61.12	0.91
STRONTIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			35.80	349.00	131.225	147.15	1.12
STRONTIUM	mg/kg	CC-BM	LAKE	B						202.00	202.00			
STRONTIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			26.70	154.00	57.828	24.19	0.42
STRONTIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			2.80	423.00	49.812	62.01	1.24
STRONTIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			47.10	190.00	82.813	32.39	0.39
THALLIUM	mg/kg	BGCR	CREEK	B	2	50	0.04				0.40	0.300	0.23	
THALLIUM	mg/kg	IHSS 200	CREEK	S		8		0.16	0.23			0.199	0.02	0.12

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
THALLIUM	mg/kg	IHSS 201	CREEK	S	2	14	0.14	0.12	0.75	0.28	0.38	0.256	0.16	0.63
THALLIUM	mg/kg	IHSS 202	CREEK	S	1	4	0.25	0.11	0.43	0.25	0.25	0.223	0.15	0.68
THALLIUM	mg/kg	IHSS 200	LAKE	S	1	36	0.03	0.18	1.30	0.95	0.95	0.398	0.26	0.66
THALLIUM	mg/kg	IHSS 201	LAKE	S		38		0.23	1.95			0.481	0.40	0.83
THALLIUM	mg/kg	IHSS 202	LAKE	S		8		0.15	1.20			0.656	0.48	0.74
TIN	mg/kg	BGCR	CREEK	B	16	54	0.30				27.10	7.640	6.09	
TIN	mg/kg	IHSS 200	CREEK	S		4		0.85	1.95			1.413	0.59	0.42
TIN	mg/kg	IHSS 201	CREEK	S		13		1.30	8.70			2.781	1.92	0.69
TIN	mg/kg	IHSS 202	CREEK	S		3		4.95	6.95			6.250	1.13	0.18
TIN	mg/kg	LOWRY	CREEK	B							15.50	13.670	2.02	
TIN	mg/kg	IHSS 200	LAKE	S	7	33	0.21	0.80	4.05	2.60	6.10	1.964	1.30	0.66
TIN	mg/kg	IHSS 201	LAKE	S	20	36	0.56	0.80	5.75	2.00	10.40	3.192	2.34	0.73
TIN	mg/kg	IHSS 202	LAKE	S	5	11	0.45	1.95	58.00	16.40	51.40	22.968	19.41	0.84
VANADIUM	mg/kg	BGCR	CREEK	B	53	57	0.93			2.00	73.00	18.330	14.30	
VANADIUM	mg/kg	IHSS 200	CREEK	S	8	8	1.00			16.10	87.70	33.913	22.62	0.67
VANADIUM	mg/kg	IHSS 201	CREEK	S	14	14	1.00			11.20	60.90	26.029	12.11	0.47
VANADIUM	mg/kg	IHSS 202	CREEK	S	4	4	1.00			28.70	51.10	37.400	9.70	0.26
VANADIUM	mg/kg	LOWRY	CREEK	B							72.90	33.310	11.66	
VANADIUM	mg/kg	CC-BM	LAKE	B						115.00	115.00			
VANADIUM	mg/kg	IHSS 200	LAKE	S	36	36	1.00			9.10	70.70	31.839	13.49	0.42
VANADIUM	mg/kg	IHSS 201	LAKE	S	43	43	1.00			4.90	50.00	24.300	12.17	0.50
VANADIUM	mg/kg	IHSS 202	LAKE	S	15	15	1.00			18.60	114.00	42.987	21.53	0.50
VANADIUM	mg/kg	RMNP-BM (L. Husted)	LAKE	B								27.300	0.10	
VANADIUM	mg/kg	RMNP-BM (L. Louise)	LAKE	B								35.000	6.00	
VANADIUM	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								55.000	6.00	

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
VANADIUM	mg/kg	RMNP-BM (The Loch)	LAKE	B								43.000	3.00	
ZINC	mg/kg	BGCR	CREEK	B	55	58.00	0.95			3.25	155.00	43.770	30.23	
ZINC	mg/kg	IHSS 200	CREEK	S	8	8	1.00			46.70	460.00	149.113	134.24	0.90
ZINC	mg/kg	IHSS 201	CREEK	S	14	14	1.00			53.00	1170.00	422.243	384.51	0.91
ZINC	mg/kg	IHSS 202	CREEK	S	4	4	1.00			44.60	56.60	49.475	5.31	0.11
ZINC	mg/kg	LOWRY	CREEK	B							726.00	76.750	124.61	
ZINC	mg/kg	CC-BM	LAKE	B						158.00	158.00			
ZINC	mg/kg	IHSS 200	LAKE	S	36	36	1.00			28.50	540.00	195.339	145.76	0.75
ZINC	mg/kg	IHSS 201	LAKE	S	43	43	1.00			9.00	1120.00	425.593	392.51	0.92
ZINC	mg/kg	IHSS 202	LAKE	S	15	15	1.00			40.50	193.00	81.247	34.67	0.43
ZINC	mg/kg	RMNP-BM (L. Husted)	LAKE	B								117.000	2.00	
ZINC	mg/kg	RMNP-BM (L. Louise)	LAKE	B								125.000	3.00	
ZINC	mg/kg	RMNP-BM (L. Haiyaha)	LAKE	B								72.000	4.00	
ZINC	mg/kg	RMNP-BM (The Loch)	LAKE	B								95.000	9.00	
RADIONUCLIDES														
AMERICIUM-241	pCi/g	BGCR	CREEK	B	59	59	1.00			-0.01	0.82	0.070	0.19	
AMERICIUM-241	pCi/g	IHSS 200	CREEK	S	5	5	1.00			0.00	0.06	0.017	0.02	1.43
AMERICIUM-241	pCi/g	IHSS 201	CREEK	S	13	13	1.00			0.00	0.08	0.022	0.03	1.19
AMERICIUM-241	pCi/g	IHSS 202	CREEK	S	4	4	1.00			0.02	0.05	0.030	0.01	0.39
AMERICIUM-241	pCi/g	IHSS 200	LAKE	S	34	34	1.00			0.01	0.21	0.043	0.05	1.20
AMERICIUM-241	pCi/g	IHSS 201	LAKE	S	39	39	1.00			0.00	0.11	0.017	0.02	1.36
AMERICIUM-241	pCi/g	IHSS 202	LAKE	S	15	15	1.00			0.01	0.09	0.049	0.03	0.52
CESIUM-136	pCi/g	BGCR	CREEK	B							1.50	0.260		

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
CESIUM-137	pCi/g	IHSS 200	CREEK	S	6	6	1.00			0.05	0.57	0.179	0.21	1.15
CESIUM-137	pCi/g	IHSS 200	LAKE	S	14	14	1.00			0.03	0.19	0.080	0.05	0.66
CESIUM-137	pCi/g	IHSS 201	LAKE	S		8						0.048	0.00	0.10
GROSS ALPHA	pCi/g	BGCR	CREEK	B	45	45	1.00			2.92	72.00	22.980	0.38	
GROSS ALPHA	pCi/g	IHSS 200	CREEK	S	8	8	1.00			15.00	28.00	19.849	4.49	0.23
GROSS ALPHA	pCi/g	IHSS 201	CREEK	S	14	14	1.00			8.30	33.00	18.513	6.66	0.36
GROSS ALPHA	pCi/g	IHSS 202	CREEK	S	4	4	1.00			17.00	43.00	25.900	12.12	0.47
GROSS ALPHA	pCi/g	IHSS 200	LAKE	S	34	34	1.00			3.80	37.00	24.269	7.74	0.32
GROSS ALPHA	pCi/g	IHSS 201	LAKE	S	42	42	1.00			4.40	39.00	19.034	7.81	0.41
GROSS ALPHA	pCi/g	IHSS 202	LAKE	S	15	15	1.00			15.13	84.00	32.578	17.61	0.54
GROSS BETA	pCi/g	BGCR	CREEK	B	43	43	1.00				59.00	35.350	20.46	
GROSS BETA	pCi/g	IHSS 200	CREEK	S	8	8	1.00			20.00	37.56	26.839	5.93	0.22
GROSS BETA	pCi/g	IHSS 201	CREEK	S	14	14	1.00			17.00	36.00	27.541	4.48	0.16
GROSS BETA	pCi/g	IHSS 202	CREEK	S	4	4	1.00			20.00	31.00	23.250	5.25	0.23
GROSS BETA	pCi/g	IHSS 200	LAKE	S	34	34	1.00			9.20	37.50	25.050	4.93	0.20
GROSS BETA	pCi/g	IHSS 201	LAKE	S	42	42	1.00			8.80	56.61	25.961	8.69	0.33
GROSS BETA	pCi/g	IHSS 202	LAKE	S	15	15	1.00			27.00	53.00	32.987	6.70	0.20
PLUTONIUM-239/240	pCi/g	BGCR	CREEK	B	42	42	1.00			0.00	2.36	0.170	0.59	
PLUTONIUM-239/240	pCi/g	IHSS 200	CREEK	S	8	8	1.00			0.00	0.55	0.156	0.20	1.29
PLUTONIUM-239/240	pCi/g	IHSS 201	CREEK	S	14	14	1.00			-0.01	0.47	0.082	0.16	1.97
PLUTONIUM-239/240	pCi/g	IHSS 202	CREEK	S	4	4	1.00			0.05	0.17	0.091	0.06	0.60
PLUTONIUM-239/240	pCi/g	BGCR	LAKE	B						0.02	0.13	0.130		
PLUTONIUM-239/240	pCi/g	IHSS 200	LAKE	S	87	87	1.00			0.00	3.30	0.267	0.59	2.23

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
PLUTONIUM-239/240	pCi/g	IHSS 201	LAKE	S	105	105	1.00			-0.02	0.55	0.033	0.06	1.81
PLUTONIUM-239/240	pCi/g	IHSS 202	LAKE	S	15	15	1.00			0.03	0.49	0.291	0.16	0.57
RADIUM-226	pCi/g	BGCR	CREEK	B	21	21	1.00			0.43	1.80	0.850	0.36	
RADIUM-226	pCi/g	IHSS 200	CREEK	S	6	6	1.00			0.85	1.20	1.067	0.15	0.14
RADIUM-226	pCi/g	IHSS 200	LAKE	S	14	14	1.00			0.84	2.20	1.124	0.34	0.30
RADIUM-226	pCi/g	IHSS 201	LAKE	S	8	8	1.00			0.28	1.40	0.790	0.35	0.44
RADIUM-228	pCi/g	IHSS 200	CREEK	S	6	6	1.00			0.97	1.70	1.328	0.23	0.18
RADIUM-228	pCi/g	IHSS 200	LAKE	S	14	14	1.00			0.92	2.20	1.444	0.37	0.26
RADIUM-228	pCi/g	IHSS 201	LAKE	S	8	8	1.00			0.31	1.60	1.000	0.49	0.49
STRONTIUM-89/90	pCi/g	BGCR	CREEK	B	43	43	1.00			-0.60	1.17	0.210	0.27	
STRONTIUM-89/90	pCi/g	IHSS 200	CREEK	S	6	6	1.00			0.13	0.30	0.220	0.08	0.37
STRONTIUM-89/90	pCi/g	IHSS 200	LAKE	S	13	13	1.00			0.11	0.57	0.309	0.14	0.46
STRONTIUM-89/90	pCi/g	IHSS 201	LAKE	S	8	8	1.00			0.14	0.72	0.326	0.19	0.57
TRITIUM	pCi/L	BGCR	CREEK	B	41	41	1.00			-23.20	380.00	155.870	91.83	
TRITIUM	pCi/L	IHSS 200	CREEK	S	3	3	1.00			-81.00	170.00	51.930	126.16	2.43
TRITIUM	pCi/L	IHSS 201	CREEK	S	4	4	1.00			77.00	159.60	112.015	39.34	0.35
TRITIUM	pCi/L	IHSS 200	LAKE	S	9	9	1.00			-36.00	160.90	76.244	78.21	1.03
URANIUM-233/234	pCi/g	BGCR	CREEK	B	47	47	1.00			0.14	4.50	1.680	1.15	
URANIUM-233/234	pCi/g	IHSS 200	CREEK	S	7	7	1.00			0.94	2.66	1.369	0.58	0.43
URANIUM-233/234	pCi/g	IHSS 201	CREEK	S	14	14	1.00			0.62	4.70	1.452	1.03	0.71
URANIUM-233/234	pCi/g	IHSS 202	CREEK	S	4	4	1.00			0.96	2.09	1.288	0.54	0.42
URANIUM-233/234	pCi/g	BM	LAKE	B						5.51	226.40	11.400		

Table B-1

SUMMARY STATISTICS FOR OU 3 SURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Unit	Data Source	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean	Standard Deviation	Coefficient of Variation
URANIUM-233/234	pCi/g	IHSS 200	LAKE	S	35	35	1.00			5.40	5.40		0.83	0.62
URANIUM-233/234	pCi/g	IHSS 201	LAKE	S	37	37	1.00			0.22	2.67	1.238	0.72	0.58
URANIUM-233/234	pCi/g	IHSS 202	LAKE	S	15	15	1.00			0.66	3.50	1.407	0.63	0.45
URANIUM-235	pCi/g	BGCR	CREEK	B	49	49	1.00			0.40	0.19	0.060	0.05	
URANIUM-235	pCi/g	IHSS 200	CREEK	S	7	7	1.00			0.03	0.20	0.072	0.06	0.86
URANIUM-235	pCi/g	IHSS 201	CREEK	S	14	14	1.00			0.03	0.20	0.078	0.04	0.58
URANIUM-235	pCi/g	IHSS 202	CREEK	S	4	4	1.00			0.06	0.14	0.085	0.04	0.44
URANIUM-235	pCi/g	BM	LAKE	B						5.51		11.400		
URANIUM-235	pCi/g	IHSS 200	LAKE	S	35	35	1.00			0.01	0.56	0.071	0.09	1.29
URANIUM-235	pCi/g	IHSS 201	LAKE	S	37	37	1.00			0.00	0.12	0.045	0.03	0.75
URANIUM-235	pCi/g	IHSS 202	LAKE	S	15	15	1.00			0.01	0.17	0.064	0.04	0.68
URANIUM-238	pCi/g	BGCR	CREEK	B	30	30	1.00			0.27	3.82	1.400		
URANIUM-238	pCi/g	IHSS 200	CREEK	S	7	7	1.00			0.87	2.23	1.400	0.51	0.36
URANIUM-238	pCi/g	IHSS 201	CREEK	S	14	14	1.00			0.62	3.90	1.339	0.84	0.63
URANIUM-238	pCi/g	IHSS 202	CREEK	S	4	4	1.00			0.79	2.15	1.205	0.63	0.53
URANIUM-238	pCi/g	BM	LAKE	B						5.51		11.400		
URANIUM-238	pCi/g	IHSS 200	LAKE	S	35	35	1.00			0.31	4.40	1.339	0.70	0.52
URANIUM-238	pCi/g	IHSS 201	LAKE	S	37	37	1.00			0.20	2.42	1.223	0.70	0.57
URANIUM-238	pCi/g	IHSS 202	LAKE	S	15	15	1.00			0.86	3.30	1.502	0.57	0.38

BGCR = Background Geochemical Characterization Report (DOE, 1993c).
CC-BM = Cherry Creek Reservoir Surface Sediment (n=1) CCBA, 1994.
RMNP-BM = Rocky Mountain National Park Lakes Surface Sediment Data (Heit, et al., 1984).
RMNP-BMS = Rocky Mountain National Park Lakes Subsurface Sediment Data (Heit, et al., 1984).
Lowry = Lowry Landfill Site Background Data (Stream Sediment) (EPA, 1992a).
BM = Marston Lake, Ralston Reservoir, Sterling Quad, Greeley Quad, Surface Sediment Data.

IHSS = Individual Hazardous Substance Site.
B = Background.
S = OU 3 (onsite).

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE		Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation
METALS															
ALUMINUM	mg/kg	OU 3	IHSS 200	LAKE	S	46	46	1.00			6340.00	26100.00	13893.70	5457.02	0.39
ALUMINUM	mg/kg	CC-BM	CC-BM	LAKE	B						96700.00	96700.00			
ALUMINUM	mg/kg	BGCR		CREEK	B	59	59	1.00			549.00	25200.00	5887.610	4912.73	
ALUMINUM	mg/kg	LOWRY	LOWRY	CREEK	B							32100.00	13959.330	7080.88	
ARSENIC	mg/kg	OU 3	IHSS 200	LAKE	S	46	46	1.00			3.60	10.40	6.49	1.67	0.26
ARSENIC	mg/kg	CC-BM		LAKE	B						5.57	5.57			
ARSENIC	mg/kg	BGCR		CREEK	B	53	59	0.90			0.20	17.30	2.410	2.45	
ARSENIC	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								0.790	0.05	
ARSENIC	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								1.000		
ARSENIC	mg/kg	LOWRY		CREEK	B							16.50	4.810	3.95	
ARSENIC	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								2.50	0.200	
ARSENIC	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								2.50	0.300	
ARSENIC	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								8.40	0.200	
ARSENIC	mg/kg	RMNP-BM	THE LOCH	LAKE	B								1.40	0.200	
BARIUM	mg/kg	OU 3	IHSS 200	LAKE	S	46	46	1.00			81.90	205.00	161.61	28.96	0.18
BARIUM	mg/kg	CC-BM		LAKE	B						591.00	591.00			
BARIUM	mg/kg	BGCR		CREEK	B	57	57	1.00			10.60	244.00	77.910	56.38	
BARIUM	mg/kg	LOWRY		CREEK	B							440.00	220.640	76.59	
BERYLLIUM	mg/kg	OU 3	IHSS 200	LAKE	S	46	46	1.00			0.53	2.30	1.13	0.33	0.29
BERYLLIUM	mg/kg	CC-BM		LAKE	B						4.03	4.03			
BERYLLIUM	mg/kg	BGCR		CREEK	B	27	57	0.47			1.50	1.30	0.660	1.69	
BERYLLIUM	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								3.900	0.30	
BERYLLIUM	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								7.400		
BERYLLIUM	mg/kg	LOWRY		CREEK	B								2.10	1.04	
BERYLLIUM	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								3.90	1.00	
BERYLLIUM	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								5.00	3.00	
BERYLLIUM	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								9.30	1.10	
BERYLLIUM	mg/kg	RMNP-BM	THE LOCH	LAKE	B								7.40	1.30	
CADMIUM	mg/kg	OU 3	IHSS 200	LAKE	S	22	46	0.48	0.38	0.81	0.59	2.60	0.74	0.62	0.84
CADMIUM	mg/kg	CC-BM		LAKE	B										
CADMIUM	mg/kg	BGCR		CREEK	B	6	51	0.12			0.13	1.30	0.540	0.36	
CADMIUM	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								0.320	0.07	
CADMIUM	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								0.090		
CADMIUM	mg/kg	LOWRY		CREEK	B							3.80	1.040	0.99	
CADMIUM	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								0.700	0.04	

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE		Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation
CADMIUM	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								0.500	0.20	
CADMIUM	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								0.340	0.03	
CADMIUM	mg/kg	RMNP-BM	THE LOCH	LAKE	B								0.320	0.05	
CALCIUM	mg/kg	OU 3	IHSS 200	LAKE	S	46	46	1.00			3900.00	15400.00	7568.70	2482.67	0.33
CALCIUM	mg/kg	CC-BM		LAKE	B										
CALCIUM	mg/kg	BGCR		CREEK	B	58	59	0.98			93.50	17100.00	3658.240	4663.60	
CALCIUM	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								12.000	2.00	
CALCIUM	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								26.500		
CALCIUM	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								26.000	1.00	
CALCIUM	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								34.100	0.10	
CALCIUM	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								54.000	5.00	
CALCIUM	mg/kg	RMNP-BM	THE LOCH	LAKE	B								47.000	6.00	
CESIUM	mg/kg	IHSS 200		LAKE	S	26	46	0.57	12.70	27.40	12.70	39.20	16.74	7.64	0.46
CESIUM	mg/kg	BGCR		CREEK	B	10	56	0.18				157.00	69.290	63.88	
CHROMIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			6.80	28.10	15.03	5.50	0.37
CHROMIUM	mg/kg	BGCR		CREEK	B	47	59	0.80			0.48	29.70	8.130	7.42	
CHROMIUM	mg/kg	LOWRY		CREEK	B							22.90	12.350	5.54	
COBALT	mg/kg	IHSS 200		LAKE	S	46	46	1.00			5.90	12.20	9.35	1.38	0.15
COBALT	mg/kg	CC-BM		LAKE	B						21.30	21.30			
COBALT	mg/kg	BGCR		CREEK	B	43	59	0.73			0.30	15.00	5.040	3.29	
COBALT	mg/kg	LOWRY		CREEK	B							14.00	9.200	2.86	
COPPER	mg/kg	IHSS 200		LAKE	S	46	46	1.00			15.80	311.00	94.69	78.64	0.83
COPPER	mg/kg	CC-BM		LAKE	B						43.40	43.40			
COPPER	mg/kg	BGCR		CREEK	B	43	59	0.73			10.15	36.70	10.150	7.86	
COPPER	mg/kg	LOWRY		CREEK	B							48.30	17.580	8.98	
CYANIDE	mg/kg	IHSS 200		LAKE	S		46	0.00	0.34	0.75			0.491	0.20	
IRON	mg/kg	IHSS 200		LAKE	S	46	46	1.00			9330.00	25600.00	17028.91	4005.91	0.24
IRON	mg/kg	CC-BM		LAKE	B						49700.00	49700.00			
IRON	mg/kg	BGCR		CREEK	B	59	59	1.00			1040.00	31400.00	8852.630	6263.19	
IRON	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								1100.000	100.00	
IRON	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								1900.000		
IRON	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								1600.000	40.00	
IRON	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								2400.000	100.00	
IRON	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								6200.000	900.00	
IRON	mg/kg	RMNP-BM	THE LOCH	LAKE	B								2300.000	300.00	

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE		Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation
LEAD	mg/kg	IHSS 200		LAKE	S	46	46	1.00			14.50	126.00	47.21	27.02	0.57
LEAD	mg/kg	CC-BM		LAKE	B						55.00	55.00			
LEAD	mg/kg	BGCR		CREEK	B	59	59	1.00			2.10	244.00	22.020	36.79	
LEAD	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								10.000	7.00	
LEAD	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								14.000		
LEAD	mg/kg	LOWRY		CREEK	B							380.00	28.290	66.79	
LEAD	mg/kg	RMNP-BM	L.HUSTED	LAKE	B										
LEAD	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								43.000	0.00	
LEAD	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								26.000	2.00	
LEAD	mg/kg	RMNP-BM	THE LOCH	LAKE	B								14.000	2.00	
LITHIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			5.40	19.60	11.66	3.90	0.33
LITHIUM	mg/kg	BGCR		CREEK	B	41	57	0.72			1.15	20.20	7.480	5.26	
MAGNESIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			1850.00	5080.00	3340.22	842.84	0.25
MAGNESIUM	mg/kg	BGCR		CREEK	B	54	59	0.92			125.50	5850.00	1473.770	1252.57	
MANGANESE	mg/kg	IHSS 200		LAKE	S	46	46	1.00			153.00	772.00	363.80	158.99	0.44
MANGANESE	mg/kg	CC-BM		LAKE	B						739.00	739.00			
MANGANESE	mg/kg	BGCR		CREEK	B	58	59	0.98			9.00	1280.00	227.820	215.48	
MANGANESE	mg/kg			CREEK	B							1560.00	605.100	281.36	
MERCURY	mg/kg	IHSS 200		LAKE	S	34	46	0.74	0.06	0.10	0.07	0.30	0.15	0.09	0.58
MERCURY	mg/kg	CC-BM		LAKE	B						0.06	0.06			
MERCURY	mg/kg	BGCR		CREEK	B	2	49	0.04			0.01	0.05	0.080	0.06	
MERCURY	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								0.030		
MERCURY	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								0.050		
MERCURY	mg/kg	LOWRY		CREEK	B							0.29	0.080	0.06	
MERCURY	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								0.030	0.01	
MERCURY	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								0.065	0.01	
MERCURY	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								0.050	0.00	
MERCURY	mg/kg	RMNP-BM	THE LOCH	LAKE	B								0.040	0.01	
MOLYBDENUM	mg/kg	IHSS 200		LAKE	S	13	46	0.28	0.43	0.93	0.84	5.00	0.87	1.11	1.28
MOLYBDENUM	mg/kg	CC-BM		LAKE	B						22.00	22.00			
MOLYBDENUM	mg/kg	BGCR		CREEK	B	16	58	0.28			0.33	9.60	4.470	5.23	
NICKEL	mg/kg	IHSS 200		LAKE	S	46	46	1.00			11.20	23.60	17.24	2.81	0.16
NICKEL	mg/kg	CC-BM		LAKE	B						26.20	26.20			
NICKEL	mg/kg	BGCR		CREEK	B	39	57	0.68			0.65	25.60	6.750	5.38	
NICKEL	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								4.200	0.08	
NICKEL	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								9.000		
NICKEL	mg/kg	LOWRY		CREEK	B							131.00	15.450	22.29	

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE		Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation
NICKEL	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								9.600	0.20	
NICKEL	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								10.000	0.00	
NICKEL	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								12.300	0.60	
NICKEL	mg/kg	RMNP-BM	THE LOCH	LAKE	B								18.000	2.00	
POTASSIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			973.00	4000.00	2155.07	804.89	0.37
POTASSIUM	mg/kg	CC-BM		LAKE	B						15100.00	15100.00			
POTASSIUM	mg/kg	BGCR		CREEK	B	43	58	0.74			57.00	3770.00	835.340	749.42	
SELENIUM	mg/kg	IHSS 200		LAKE	S	5	46	0.11	0.83	1.90	0.86	2.45	0.75	0.32	0.43
SELENIUM	mg/kg	CC-BM		LAKE	B						1.10	1.10			
SELENIUM	mg/kg	BGCR		CREEK	B	13	58	0.22			0.10	2.90	0.420	0.56	
SELENIUM	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								0.900	0.20	
SELENIUM	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								0.760		
SELENIUM	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								1.800	0.10	
SELENIUM	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								1.200	0.10	
SELENIUM	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								1.800	0.40	
SELENIUM	mg/kg	RMNP-BM	THE LOCH	LAKE	B								1.100	0.30	
SILVER	mg/kg	IHSS 200		LAKE	S	35	46	0.76	0.92	1.90	1.00	16.50	3.48	3.85	1.11
SILVER	mg/kg	CC-BM		LAKE	B						0.05	0.05			
SILVER	mg/kg	BGCR		CREEK	B	2	54	0.04			0.20	3.40	0.660	0.52	
SODIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			74.60	224.00	136.05	29.69	0.22
SODIUM	mg/kg	BGCR		CREEK	B	47	54	0.80			162.00	637.00	161.470	136.80	
STRONTIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			35.00	88.40	61.05	12.54	0.21
STRONTIUM	mg/kg	CC-BM		LAKE	B						202.00	202.00			
STRONTIUM	mg/kg	BGCR		CREEK	B	48	58	0.83			2.80	421.00	36.380	59.87	
THALLIUM	mg/kg	IHSS 200		LAKE	S		46		0.36	1.20			0.35	0.12	0.35
THALLIUM	mg/kg	BGCR		CREEK	B	2	50	0.04				0.40	0.300	0.23	
TIN	mg/kg	IHSS 200		LAKE	S	17	46	0.37	1.60	3.30	1.70	6.00	2.16	1.47	0.68
TIN	mg/kg	BGCR		CREEK	B	16	54	0.30				27.10	7.640	6.09	
TIN	mg/kg	LOWRY		CREEK	B							15.50	13.670	2.02	
VANADIUM	mg/kg	IHSS 200		LAKE	S	46	46	1.00			17.20	60.40	36.11	11.28	0.31
VANADIUM	mg/kg	CC-BM		LAKE	B						115.00	115.00			
VANADIUM	mg/kg	BGCR		CREEK	B	53	57	0.93			2.00	73.00	18.330	14.30	
VANADIUM	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								15.000	3.00	
VANADIUM	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								32.800		
VANADIUM	mg/kg	LOWRY		CREEK	B							72.90	33.310	11.66	

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE		Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation
VANADIUM	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								27.300	0.10	
VANADIUM	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								35.000	6.00	
VANADIUM	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								55.000	6.00	
VANADIUM	mg/kg	RMNP-BM	THE LOCH	LAKE	B								43.000	3.00	
ZINC	mg/kg	IHSS 200		LAKE	S	46	46	1.00			46.20	480.00	186.65	108.62	0.58
ZINC	mg/kg	CC-BM		LAKE	B						158.00	158.00			
ZINC	mg/kg	BGCR		CREEK	B	55	58.00	0.95			3.25	155.00	43.770	30.23	
ZINC	mg/kg	RMNP-BMS	L.HUSTED	LAKE	B								80.000	13.00	
ZINC	mg/kg	RMNP-BMS	L.LOUISE	LAKE	B								155.000		
ZINC	mg/kg	LOWRY		CREEK	B							726.00	76.750	124.61	
ZINC	mg/kg	RMNP-BM	L.HUSTED	LAKE	B								117.000	2.00	
ZINC	mg/kg	RMNP-BM	L.LOUISE	LAKE	B								125.000	3.00	
ZINC	mg/kg	RMNP-BM	L.HAIYAHA	LAKE	B								72.000	4.00	
ZINC	mg/kg	RMNP-BM	THE LOCH	LAKE	B								95.000	9.00	
RADIONUCLIDES															
AMERICIUM-241	pCi/g	OU 3	IHSS 200	LAKE	S	40	40	1.00			0.00	1.02	0.24	0.31	1.31
AMERICIUM-241	pCi/g		BGCR	CREEK	B	35	35	1.00			-0.01	0.82	0.070	0.19	
PLUTONIUM-239/240	pCi/g	OU 3	IHSS 200	LAKE	S	60	60	1.00			0.00	4.03	0.73	1.07	1.46
PLUTONIUM-239/240	pCi/g		BGCR	CREEK	B	42	42	1.00			0.00	2.36	0.170	0.59	
PLUTONIUM-239/240	pCi/g		BM	LAKE	B						0.02	0.13	0.130		
PLUTONIUM-239/241	pCi/g	HR-BM	HALLIGAN	LAKE	B						0.02	0.05			
PLUTONIUM-239/242	pCi/g	WL-BM	WELLINGTON	LAKE	B						0.07	0.19			
POLONIUM-210	pCi/g	OU 3	IHSS 200	LAKE	S	41	41	1.00			1.05	3.14	2.00	0.53	0.26
URANIUM-233/234	pCi/g	OU 3	IHSS 200	LAKE	S	64	64	1.00			0.75	3.90	1.32	0.41	0.31
URANIUM-233/234	pCi/g		BGCR	CREEK	B	47	47	1.00			0.14	4.50	1.680	1.15	
URANIUM-233/234	pCi/g		BM	LAKE	B						5.51	11.400			
URANIUM-235	pCi/g	OU 3	IHSS 200	LAKE	S	64	64	1.00			-0.01	0.21	0.06	0.04	0.64
URANIUM-235	pCi/g		BGCR	CREEK	B	49	49	1.00			0.40	0.19	0.060	0.05	
URANIUM-235	pCi/g		BM	LAKE	B						5.51	11.400			
URANIUM-238	pCi/g	OU 3	IHSS 200	LAKE	S	64	64	1.00			0.72	3.30	1.37	0.37	0.27
URANIUM-238	pCi/g		BGCR	CREEK	B	36	36	1.00			0.27	3.82	1.400	1.03	
URANIUM-238	pCi/g		BM	LAKE	B						5.51	11.400			

Table B-2

SUMMARY STATISTICS FOR GREAT WESTERN RESERVOIR SUBSURFACE SEDIMENTS
COMPARISON TO BENCHMARK DATA

Chemical Name	Units	DATA SOURCE	Lake or Creek	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Arithmetic Mean	Standard Deviation	Coefficient of Variation

B = Background.
BGCR = Background Geochemical Characterization Report (DOE, 1993c).
BM = Marston Lake, Ralston Reservoir, Sterling Quad, Greeley Quad, Surface Sediment Data.
CC-BM = Cherry Creek Reservoir Surface Sediment (n = 1) (CCBA, 1994).
HR-BM = Halligan Reservoir Subsurface Sediment Data (Cohen et al., 1990).
IHSS = Individual Hazardous Substance Site.
Lowry = Lowry Landfill Site Background Data (Stream Sediment) (EPA, 1992a).
RMNP-BM = Rocky Mountain *National Park Lakes Surface Sediment Data (Heit, et al., 1984)*
RMNP-BMS = Rocky Mountain National Park Lakes Subsurface Sediment Data (Heit, et al., 1984)
S = OU 3 (onsite).
WL-BM = Wellington Lake Subsurface Sediment Data (Cohen et al., 1990).

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
METALS														
DISSOLVED-METALS	ALUMINUM	µg/L	BGCR	B	56	133	0.42	9.00	454.00	13.30	1050.00	87.33	160.32	1.84
DISSOLVED-METALS	ALUMINUM	µg/L	CREEK	S	2	3	0.67	17.30	17.30	455.00	739.00	400.88	368.17	0.92
DISSOLVED-METALS	ALUMINUM	µg/L	200	S	12	16	0.75	14.70	17.30	15.20	3230.00	448.56	938.07	2.09
DISSOLVED-METALS	ALUMINUM	µg/L	201	S	12	17	0.71	14.70	17.30	16.40	455.00	70.16	140.78	2.01
DISSOLVED-METALS	ALUMINUM	µg/L	202	S	5	13	0.38	14.70	17.30	17.50	47.80	16.35	14.61	0.89
TOTAL-METALS	ALUMINUM	µg/L	BGCR	B	106	139	0.76	18.70	988.00	25.00	6560.00	758.89	1360.09	1.79
TOTAL-METALS	ALUMINUM	µg/L	CREEK	S	8	8	1.00			344.00	1990.00	1042.88	668.61	0.64
TOTAL-METALS	ALUMINUM	µg/L	200	S	19	19	1.00			32.20	4260.00	1402.48	1035.07	0.74
TOTAL-METALS	ALUMINUM	µg/L	201	S	20	20	1.00			65.20	1540.00	404.47	356.02	0.88
TOTAL-METALS	ALUMINUM	µg/L	202	S	13	13	1.00			25.90	196.00	92.55	55.66	0.60
TOTAL-METALS	ALUMINUM	µg/L	BM-LK	B		126					2627.00	187-665		
DISSOLVED-METALS	ANTIMONY	µg/L	BGCR	B	20	91	0.22	7.50	104.00	7.50	35.10	15.91	10.14	0.64
DISSOLVED-METALS	ANTIMONY	µg/L	CREEK	S	0	2	0.00	16.50	16.50			8.25		
DISSOLVED-METALS	ANTIMONY	µg/L	200	S		16		14.80	16.50			7.77	0.44	0.06
DISSOLVED-METALS	ANTIMONY	µg/L	201	S		17		14.80	16.50			7.80	0.44	0.06
DISSOLVED-METALS	ANTIMONY	µg/L	202	S		13		14.80	16.50			7.73	0.43	0.06
TOTAL-METALS	ANTIMONY	µg/L	BGCR	B	13	119	0.11	7.00	60.00	7.30	54.80	14.28	9.72	0.68
TOTAL-METALS	ANTIMONY	µg/L	CREEK	S	0	8	0.00	14.80	19.80			8.66	1.09	0.13
TOTAL-METALS	ANTIMONY	µg/L	200	S		19		14.80	19.80			8.11	0.89	0.11
TOTAL-METALS	ANTIMONY	µg/L	201	S		20		14.80	16.50			7.78	0.43	0.06
TOTAL-METALS	ANTIMONY	µg/L	202	S		13		14.80	16.50			7.73	0.43	0.06
TOTAL-METALS	ANTIMONY	µg/L	BM-LK	B		46					86.00			
DISSOLVED-METALS	ARSENIC	µg/L	BGCR	B	4	93	0.04	0.70	10.00	0.90	1.60	1.27	1.26	1.00
DISSOLVED-METALS	ARSENIC	µg/L	CREEK	S	0	3	0.00	2.60	2.60			1.30		
DISSOLVED-METALS	ARSENIC	µg/L	200	S	3	16	0.19	1.90	2.90	2.40	2.40	1.46	0.51	0.35
DISSOLVED-METALS	ARSENIC	µg/L	201	S	1	18	0.06	1.90	3.20	2.90	2.90	1.36	0.46	0.34
DISSOLVED-METALS	ARSENIC	µg/L	202	S	13	13	1.00			2.90	6.30	4.14	0.99	0.24
DISSOLVED-METALS	ARSENIC	µg/L	BM-CR	B		16		5.00	5.00					
DISSOLVED-METALS	ARSENIC	µg/L	BM-LK	B		5					1.00			
TOTAL-METALS	ARSENIC	µg/L	BGCR	B	15	110	0.14	0.50	11.50	1.00	2.90	1.59	1.55	0.98

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
TOTAL-METALS	ARSENIC	µg/L	CREEK	S	3	8	0.38	2.60	3.20	0.70	1.30	1.25	0.31	0.25
TOTAL-METALS	ARSENIC	µg/L	200	S	6	19	0.32	1.90	2.90	0.70	2.90	1.32	0.59	0.44
TOTAL-METALS	ARSENIC	µg/L	201	S		20		2.20	3.20			1.45	0.18	0.13
TOTAL-METALS	ARSENIC	µg/L	202	S	13	13	1.00			3.10	6.60	4.92	0.94	0.19
TOTAL-METALS	ARSENIC	µg/L	BM-CR	B		18		5.00	5.00					
TOTAL-METALS	ARSENIC	µg/L	BM-LK	B		106					10.00			
DISSOLVED-METALS	BARIUM	µg/L	BGCR	B	102	144	0.71	24.50	200.00	18.80	391.00	48.63	34.98	0.72
DISSOLVED-METALS	BARIUM	µg/L	CREEK	S	3	3	1.00			20.70	43.10	28.40	12.74	0.45
DISSOLVED-METALS	BARIUM	µg/L	200	S	16	16	1.00			20.70	48.90	37.01	6.39	0.17
DISSOLVED-METALS	BARIUM	µg/L	201	S	18	18	1.00			21.40	43.10	35.11	4.18	0.12
DISSOLVED-METALS	BARIUM	µg/L	202	S	13	13	1.00			20.30	31.40	24.69	3.31	0.13
TOTAL-METALS	BARIUM	µg/L	BGCR	B	112	131	0.85	45.50	200.00	26.40	306.00	63.69	31.66	0.50
TOTAL-METALS	BARIUM	µg/L	CREEK	S	8	8	1.00			25.40	80.10	37.84	18.36	0.49
TOTAL-METALS	BARIUM	µg/L	200	S	19	19	1.00			27.00	80.10	43.09	11.49	0.27
TOTAL-METALS	BARIUM	µg/L	201	S	20	20	1.00			25.40	44.50	35.89	4.52	0.13
TOTAL-METALS	BARIUM	µg/L	202	S	13	13	1.00			20.40	34.70	25.98	3.60	0.14
TOTAL-METALS	BARIUM	µg/L	BM-LK	B		75					250.00	47-103		
DISSOLVED-METALS	BERYLLIUM	µg/L	BGCR	B	8	89	0.09	0.20	8.00	0.65	17.00	1.08	1.88	1.74
DISSOLVED-METALS	BERYLLIUM	µg/L	CREEK	S	0	3	0.00	0.40	0.40			0.20		
DISSOLVED-METALS	BERYLLIUM	µg/L	200	S		16		0.30	0.40			0.17	0.03	0.15
DISSOLVED-METALS	BERYLLIUM	µg/L	201	S		18		0.30	0.40			0.18	0.03	0.15
DISSOLVED-METALS	BERYLLIUM	µg/L	202	S		13		0.30	0.40			0.17	0.03	0.15
TOTAL-METALS	BERYLLIUM	µg/L	BGCR	B	9	115	0.08	0.20	5.00	0.60	4.80	0.78	0.87	1.12
TOTAL-METALS	BERYLLIUM	µg/L	CREEK	S	1	8	0.13	0.30	0.60	0.36	0.36	0.25	0.07	0.29
TOTAL-METALS	BERYLLIUM	µg/L	200	S	1	19	0.05	0.30	0.60	0.40	0.40	0.20	0.07	0.35
TOTAL-METALS	BERYLLIUM	µg/L	201	S	1	20	0.05	0.30	0.40	0.36	0.36	0.18	0.05	0.27
TOTAL-METALS	BERYLLIUM	µg/L	202	S		13		0.30	0.40			0.17	0.03	0.15
TOTAL-METALS	BERYLLIUM	µg/L	BM-LK	B		42			2.00					
DISSOLVED-METALS	CADMIUM	µg/L	BGCR	B	5	77	0.06	1.40	5.00	2.30	3.50	1.77	0.62	0.35
DISSOLVED-METALS	CADMIUM	µg/L	CREEK	S	1	3	0.33	1.40	1.40	2.50	2.50	1.30	1.04	0.80
DISSOLVED-METALS	CADMIUM	µg/L	200	S	1	16	0.06	1.40	1.50	1.50	1.50	0.78	0.19	0.25

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

NOTE:
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
DISSOLVED-METALS	CADMIUM	µg/L	201	S	2	18	0.11	1.40	1.50	2.50	2.50	0.93	0.57	0.62
DISSOLVED-METALS	CADMIUM	µg/L	202	S	1	13	0.08	1.40	1.50	1.80	1.80	0.82	0.30	0.36
DISSOLVED-METALS	CADMIUM	µg/L	BM-CR	B		33		1.00	5.00		2.50			
TOTAL-METALS	CADMIUM	µg/L	BM-LK	B		142		0.10			7.00	0.23-1.33		
TOTAL-METALS	CADMIUM	µg/L	BGCR	B	3	108	0.03	1.40	5.00	2.60	4.20	1.69	0.68	0.40
TOTAL-METALS	CADMIUM	µg/L	CREEK	S	3	8	0.38	1.40	2.30	2.40	2.80	1.47	0.93	0.63
TOTAL-METALS	CADMIUM	µg/L	200	S	3	19	0.16	1.40	2.30	1.90	2.80	1.02	0.64	0.63
TOTAL-METALS	CADMIUM	µg/L	201	S	1	20	0.05	1.40	1.50	2.40	2.40	0.81	0.37	0.46
TOTAL-METALS	CADMIUM	µg/L	202	S	2	13	0.15	1.40	1.50	4.00	9.00	1.62	2.39	1.48
DISSOLVED-METALS	CALCIUM	µg/L	BGCR	B	153	153	1.00			6760.00	79300.00	24056.86	10904.89	0.45
DISSOLVED-METALS	CALCIUM	µg/L	CREEK	S	3	3	1.00			13900.00	27200.00	18566.67	7484.87	0.40
DISSOLVED-METALS	CALCIUM	µg/L	200	S	16	16	1.00			13900.00	22000.00	19156.25	1822.44	0.10
DISSOLVED-METALS	CALCIUM	µg/L	201	S	18	18	1.00			14600.00	27200.00	23127.78	2520.46	0.11
DISSOLVED-METALS	CALCIUM	µg/L	202	S	13	13	1.00			11200.00	14200.00	12792.31	1028.32	0.08
TOTAL-METALS	CALCIUM	µg/L	BGCR	B	153	153	1.00			5505.75	74600.00	24071.96	10675.23	0.44
TOTAL-METALS	CALCIUM	µg/L	CREEK	S	8	8	1.00			11000.00	47200.00	21212.50	12141.48	0.57
TOTAL-METALS	CALCIUM	µg/L	200	S	19	19	1.00			11000.00	47200.00	19621.05	7339.13	0.37
TOTAL-METALS	CALCIUM	µg/L	201	S	20	20	1.00			12600.00	26100.00	22085.00	3340.39	0.15
TOTAL-METALS	CALCIUM	µg/L	202	S	13	13	1.00			11100.00	13900.00	12676.92	840.79	0.07
TOTAL-METALS	CALCIUM	µg/L	BM-LK	B	41						72000.00	33290-37380		
DISSOLVED-METALS	CESIUM	µg/L	BGCR	B	9	97	0.09	2.00	2500.00	60.00	200.00	355.86	281.41	0.79
DISSOLVED-METALS	CESIUM	µg/L	CREEK	S	0	3	0.00	50.00	50.00			25.00		
DISSOLVED-METALS	CESIUM	µg/L	200	S	4	16	0.25	50.00	50.00	50.00	60.00	31.88	12.50	0.39
DISSOLVED-METALS	CESIUM	µg/L	201	S	5	18	0.28	50.00	50.00	50.00	80.00	34.72	17.19	0.50
DISSOLVED-METALS	CESIUM	µg/L	202	S	4	13	0.31	50.00	50.00	50.00	80.00	36.54	19.51	0.53
TOTAL-METALS	CESIUM	µg/L	BGCR	B	10	120	0.08	2.00	2500.00	50.00	400.00	241.78	184.80	0.76
TOTAL-METALS	CESIUM	µg/L	CREEK	S	0	8	0.00	50.00	500.00			109.38	116.45	1.06
TOTAL-METALS	CESIUM	µg/L	200	S	5	19	0.26	50.00	500.00	50.00	90.00	69.21	82.15	1.19
TOTAL-METALS	CESIUM	µg/L	201	S		20		50.00	50.00			25.00		
TOTAL-METALS	CESIUM	µg/L	202	S	3	13	0.23	50.00	50.00	50.00	80.00	33.85	17.93	0.53
DISSOLVED-METALS	CHROMIUM	µg/L	BGCR	B	9	89	0.10	2.00	20.00	2.10	14.80	3.24	2.69	0.83

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
DISSOLVED-METALS	CHROMIUM	µg/L	CREEK	S	0	3	0.00	3.70	3.70			1.85		
DISSOLVED-METALS	CHROMIUM	µg/L	200	S		16		2.60	3.70			1.54	0.28	0.18
DISSOLVED-METALS	CHROMIUM	µg/L	201	S	1	18	0.06	2.60	3.70	3.80	3.80	1.71	0.59	0.34
DISSOLVED-METALS	CHROMIUM	µg/L	202	S	1	13	0.08	2.60	3.70	3.40	3.40	1.67	0.59	0.35
DISSOLVED-METALS	CHROMIUM	µg/L	BM-CR	B		14		5.00	5.00					
DISSOLVED-METALS	CHROMIUM	µg/L	BM-LK	B		5					8.00			
TOTAL-METALS	CHROMIUM	µg/L	BM-CR	B		18		5.00	5.00		5.00			
TOTAL-METALS	CHROMIUM	µg/L	BM-LK	B		145				1.00	36.00	1.52-3.67		
TOTAL-METALS	CHROMIUM	µg/L	BGCR	B	19	120	0.16	2.00	13.50	2.10	18.90	3.64	2.98	0.82
TOTAL-METALS	CHROMIUM	µg/L	CREEK	S	1	8	0.13	2.00	3.70	2.90	2.90	1.59	0.66	0.41
TOTAL-METALS	CHROMIUM	µg/L	200	S	2	19	0.11	2.00	3.70	4.30	4.40	1.72	0.97	0.57
TOTAL-METALS	CHROMIUM	µg/L	201	S	2	20	0.10	2.60	3.70	2.80	2.90	1.70	0.48	0.28
TOTAL-METALS	CHROMIUM	µg/L	202	S	1	13	0.08	2.60	3.70	65.80	65.80	6.47	17.83	2.75
DISSOLVED-METALS	COBALT	µg/L	BGCR	B	3	86	0.03	2.00	50.00	2.40	4.60	4.88	6.26	1.28
DISSOLVED-METALS	COBALT	µg/L	CREEK	S	0	3	0.00	2.30	2.30			1.15		
DISSOLVED-METALS	COBALT	µg/L	200	S	1	16	0.06	1.30	2.30	1.90	1.90	0.95	0.36	0.38
DISSOLVED-METALS	COBALT	µg/L	201	S		18		1.30	2.30			0.90	0.26	0.29
DISSOLVED-METALS	COBALT	µg/L	202	S	1	13	0.08	1.30	2.30	1.80	1.80	0.93	0.36	0.39
TOTAL-METALS	COBALT	µg/L	BGCR	B	8	116	0.07	2.00	50.00	2.70	7.90	5.35	8.07	1.51
TOTAL-METALS	COBALT	µg/L	CREEK	S	0	8	0.00	1.30	2.70			1.10	0.29	0.27
TOTAL-METALS	COBALT	µg/L	200	S	3	19	0.16	1.30	2.70	1.50	2.60	1.14	0.47	0.42
TOTAL-METALS	COBALT	µg/L	201	S	2	20	0.10	1.30	2.30	1.30	1.90	0.97	0.34	0.35
TOTAL-METALS	COBALT	µg/L	202	S		13		1.30	2.30			0.84	0.25	0.30
TOTAL-METALS	COBALT	µg/L	BM-LK	B		5					4.00	1.00		
DISSOLVED-METALS	COPPER	µg/L	BGCR	B	48	124	0.39	2.00	25.70	2.40	28.00	6.07	5.12	0.84
DISSOLVED-METALS	COPPER	µg/L	CREEK	S	2	3	0.67	2.40	2.40	5.50	8.10	4.93	3.48	0.71
DISSOLVED-METALS	COPPER	µg/L	200	S	9	16	0.56	1.90	2.40	2.00	9.40	3.15	2.67	0.85
DISSOLVED-METALS	COPPER	µg/L	201	S	6	18	0.33	1.90	2.40	1.90	8.10	1.77	1.66	0.94
DISSOLVED-METALS	COPPER	µg/L	202	S	5	12	0.42	1.90	2.40	2.10	4.50	1.94	1.19	0.62
DISSOLVED-METALS	COPPER	µg/L	BM-CR	B		34		1.00			49.00			
TOTAL-METALS	COPPER	µg/L	BM-LK	B		166		1.00			31.00	2.5-5.97		
TOTAL-METALS	COPPER	µg/L	BGCR	B	47	121	0.39	2.00	25.60	2.60	15.50	5.35	4.21	0.79

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
TOTAL-METALS	COPPER	µg/L	CREEK	S	7	8	0.88	2.30	2.30	5.80	20.90	13.24	7.40	0.56
TOTAL-METALS	COPPER	µg/L	200	S	13	15	0.87	1.90	2.30	4.30	20.90	9.25	6.35	0.69
TOTAL-METALS	COPPER	µg/L	201	S	16	17	0.94	1.90	1.90	2.80	16.50	5.84	4.25	0.73
TOTAL-METALS	COPPER	µg/L	202	S	3	13	0.23	1.90	2.40	2.20	4.50	1.58	1.11	0.70
TOTAL-METALS	CYANIDE	µg/L	BGCR	B	2	25	0.08	1.50	20.00	2.00	2.50	2.50	2.72	1.09
TOTAL-METALS	CYANIDE	µg/L	200	S		15		10.00	10.00			5.00		
TOTAL-METALS	CYANIDE	µg/L	201	S	1	16	0.063	10.00	10.00	21.50	21.50	6.03	4.13	
TOTAL-METALS	CYANIDE	µg/L	202	S		13		10.00	10.00			5.00		
DISSOLVED-METALS	IRON	µg/L	BGCR	B	107	152	0.70	3.00	316.00	9.30	1060.00	145.45	177.80	1.22
DISSOLVED-METALS	IRON	µg/L	CREEK	S	3	3	1.00			19.80	228.00	122.27	104.14	0.85
DISSOLVED-METALS	IRON	µg/L	200	S	12	15	0.80	4.00	16.30	6.60	572.00	93.62	144.89	1.55
DISSOLVED-METALS	IRON	µg/L	201	S	12	15	0.80	16.30	16.30	11.00	228.00	36.10	54.28	1.50
DISSOLVED-METALS	IRON	µg/L	202	S	13	13	1.00			7.00	71.10	35.46	22.08	0.62
DISSOLVED-METALS	IRON	µg/L	BM-CR	B		33		10.00			1900.00			
DISSOLVED-METALS	IRON	µg/L	BM-LK	B		20					80.00			
TOTAL-METALS	IRON	µg/L	BM-CR	B		35		10.00			3300.00			
TOTAL-METALS	IRON	µg/L	BM-LK	B		191		10.00			1643.00	233-631		
TOTAL-METALS	IRON	µg/L	BGCR	B	147	157	0.94	82.75	478.00	9.70	26300.00	1261.17	2865.13	2.27
TOTAL-METALS	IRON	µg/L	CREEK	S	8	8	1.00			453.00	2340.00	1218.88	719.98	0.59
TOTAL-METALS	IRON	µg/L	200	S	19	19	1.00			40.70	2340.00	1115.04	685.21	0.61
TOTAL-METALS	IRON	µg/L	201	S	20	20	1.00			37.70	1150.00	401.56	332.31	0.83
TOTAL-METALS	IRON	µg/L	202	S	13	13	1.00			56.50	328.00	156.69	75.05	0.48
DISSOLVED-METALS	LEAD	µg/L	BGCR	B	25	112	0.22	0.40	13.10	0.70	7.20	1.29	1.22	0.94
DISSOLVED-METALS	LEAD	µg/L	CREEK	S	3	3	1.00			3.60	10.20	5.93	3.70	0.62
DISSOLVED-METALS	LEAD	µg/L	200	S	16	16	1.00			1.20	5.80	3.15	1.26	0.40
DISSOLVED-METALS	LEAD	µg/L	201	S	9	18	0.50	1.00	2.20	2.10	10.20	2.65	2.61	0.99
DISSOLVED-METALS	LEAD	µg/L	202	S	12	13	0.92	1.90	1.90	2.10	11.40	4.20	2.72	0.65
DISSOLVED-METALS	LEAD	µg/L	BM-CR	B		33		1.00			14.00			
TOTAL-METALS	LEAD	µg/L	BM-LK	B		125				1.00	888.00	2.75-86		
TOTAL-METALS	LEAD	µg/L	BGCR	B	52	131	0.40	0.70	11.60	0.80	21.00	1.94	2.32	1.20
TOTAL-METALS	LEAD	µg/L	CREEK	S	8	8	1.00			0.90	11.00	7.89	3.81	0.48

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

NOTE:
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
TOTAL-METALS	LEAD	µg/L	200	S	19	19	1.00			0.90	18.50	7.04	4.49	0.64
TOTAL-METALS	LEAD	µg/L	201	S	17	20	0.85	2.00	2.70	2.50	10.70	4.34	2.89	0.67
TOTAL-METALS	LEAD	µg/L	202	S	13	13	1.00			2.40	37.20	7.22	9.78	1.35
DISSOLVED-METALS	LITHIUM	µg/L	BGCR	B	51	118	0.43	1.00	101.00	1.30	12.80	15.97	20.53	1.29
DISSOLVED-METALS	LITHIUM	µg/L	CREEK	S	3	3	1.00			5.80	12.00	7.90	3.55	0.45
DISSOLVED-METALS	LITHIUM	µg/L	200	S	15	16	0.94	3.70	3.70	3.80	8.20	5.58	1.52	0.27
DISSOLVED-METALS	LITHIUM	µg/L	201	S	18	18	1.00			5.90	12.00	7.65	1.41	0.18
DISSOLVED-METALS	LITHIUM	µg/L	202	S	13	13	1.00			6.50	10.60	8.22	1.34	0.16
TOTAL-METALS	LITHIUM	µg/L	BGCR	B	59	126	0.47	2.00	100.00	2.00	15.50	11.76	17.38	1.48
TOTAL-METALS	LITHIUM	µg/L	CREEK	S	7	7	1.00			3.50	11.10	7.40	2.54	0.34
TOTAL-METALS	LITHIUM	µg/L	200	S	18	18	1.00			3.50	8.70	6.34	1.45	0.23
TOTAL-METALS	LITHIUM	µg/L	201	S	20	20	1.00			4.90	11.10	7.72	1.63	0.21
TOTAL-METALS	LITHIUM	µg/L	202	S	13	13	1.00			5.20	9.40	7.29	1.35	0.19
TOTAL-METALS	LITHIUM	µg/L	BM-LK	B		16					8.00	4.38		
DISSOLVED-METALS	MAGNESIUM	µg/L	BGCR	B	133	149	0.89	3300.00	5000.00	1890.00	17800.00	5004.04	1987.74	0.40
DISSOLVED-METALS	MAGNESIUM	µg/L	CREEK	S	3	3	1.00			3080.00	6310.00	4303.33	1751.69	0.41
DISSOLVED-METALS	MAGNESIUM	µg/L	200	S	16	16	1.00			3080.00	4320.00	3941.88	273.31	0.07
DISSOLVED-METALS	MAGNESIUM	µg/L	201	S	18	18	1.00			3520.00	6310.00	5331.11	546.30	0.10
DISSOLVED-METALS	MAGNESIUM	µg/L	202	S	13	13	1.00			5930.00	7160.00	6627.69	452.59	0.07
DISSOLVED-METALS	MAGNESIUM	µg/L	BM-LK	B		33					66000.00	8760.00		
TOTAL-METALS	MAGNESIUM	µg/L	BGCR	B	134	146	0.92	4100.00	5000.00	1870.00	16600.00	5125.31	1924.26	0.38
TOTAL-METALS	MAGNESIUM	µg/L	CREEK	S	8	8	1.00			2940.00	11100.00	5297.50	2771.48	0.52
TOTAL-METALS	MAGNESIUM	µg/L	200	S	19	19	1.00			2940.00	11100.00	4328.42	1689.44	0.39
TOTAL-METALS	MAGNESIUM	µg/L	201	S	20	20	1.00			3450.00	6480.00	5338.00	596.74	0.11
TOTAL-METALS	MAGNESIUM	µg/L	202	S	13	13	1.00			5820.00	7340.00	6568.46	586.74	0.09
TOTAL-METALS	MAGNESIUM	µg/L	BM-LK	B		98					27000.00	9400-17600		
DISSOLVED-METALS	MANGANESE	µg/L	BGCR	B	115	148	0.78	0.94	15.00	1.00	353.00	28.47	47.75	1.68
DISSOLVED-METALS	MANGANESE	µg/L	CREEK	S	3	3	1.00			4.80	63.10	42.00	32.31	0.77
DISSOLVED-METALS	MANGANESE	µg/L	200	S	16	16	1.00			0.90	94.20	19.01	31.20	1.64
DISSOLVED-METALS	MANGANESE	µg/L	201	S	14	18	0.78	0.90	0.90	1.60	1570.00	118.88	372.43	3.13
DISSOLVED-METALS	MANGANESE	µg/L	202	S	13	13	1.00			2.70	7.90	4.85	1.73	0.36

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
DISSOLVED-METALS	MANGANESE	µg/L	BM-CR	B		33		5.00			1800.00			
DISSOLVED-METALS	MANGANESE	µg/L	BM-LK	B		20					31.00			
TOTAL-METALS	MANGANESE	µg/L	BM-LK	B		197					400.00	43.22-216.5		
TOTAL-METALS	MANGANESE	µg/L	BGCR	B	138	151	0.91	1.30	15.00	1.00	4060.00	87.07	343.53	3.95
TOTAL-METALS	MANGANESE	µg/L	CREEK	S	8	8	1.00			97.00	307.00	169.00	70.21	
TOTAL-METALS	MANGANESE	µg/L	200	S	19	19	1.00			6.80	210.00	71.51	66.18	0.93
TOTAL-METALS	MANGANESE	µg/L	201	S	20	20	1.00			5.50	1580.00	155.99	357.73	2.29
TOTAL-METALS	MANGANESE	µg/L	202	S	13	13	1.00			11.80	37.00	21.96	8.28	0.38
TOTAL-METALS	MANGANESE	µg/L	BM-CR	B		35		5.00			1800.00			
DISSOLVED-METALS	MERCURY	µg/L	BGCR	B	8	82	0.10	0.10	0.20	0.22	0.44	0.12	0.07	0.59
DISSOLVED-METALS	MERCURY	µg/L	CREEK	S		3		0.20	0.20			0.10		
DISSOLVED-METALS	MERCURY	µg/L	200	S	5	16	0.31	0.20	0.20	0.13	0.13	0.11	0.01	0.13
DISSOLVED-METALS	MERCURY	µg/L	201	S		18		0.10	0.20			0.09	0.02	0.27
DISSOLVED-METALS	MERCURY	µg/L	202	S	2	13	0.15	0.10	0.20	0.20	0.20	0.10	0.05	0.54
DISSOLVED-METALS	MERCURY	µg/L	BM-CR	B		34		0.10			0.20			
TOTAL-METALS	MERCURY	µg/L	BM-LK	B		112		0.10			9.00	0.05-0.36		
TOTAL-METALS	MERCURY	µg/L	BGCR	B	9	122	0.07	0.10	0.42	0.20	1.40	0.13	0.16	1.21
TOTAL-METALS	MERCURY	µg/L	CREEK	S	2	8	0.25	0.20	0.20	0.12	0.12	0.11	0.01	0.09
TOTAL-METALS	MERCURY	µg/L	200	S		19		0.10	0.20			0.09	0.02	0.26
TOTAL-METALS	MERCURY	µg/L	201	S	3	20	0.15	0.10	0.20	0.12	0.82	0.13	0.16	1.28
TOTAL-METALS	MERCURY	µg/L	202	S	2	13	0.15	0.10	0.20	0.20	0.30	0.10	0.07	0.69
DISSOLVED-METALS	MOLYBDENUM	µg/L	BGCR	B	14	92	0.15	2.00	500.00	2.50	23.40	33.19	49.35	1.49
DISSOLVED-METALS	MOLYBDENUM	µg/L	CREEK	S	3	3	1.00			3.40	6.60	4.77	1.65	0.35
DISSOLVED-METALS	MOLYBDENUM	µg/L	200	S	16	16	1.00			2.00	7.00	4.64	1.49	0.32
DISSOLVED-METALS	MOLYBDENUM	µg/L	201	S	18	18	1.00			2.70	8.80	5.17	1.44	0.28
DISSOLVED-METALS	MOLYBDENUM	µg/L	202	S	2	13	0.15	1.70	2.70	2.70	3.10	1.36	0.73	0.54
TOTAL-METALS	MOLYBDENUM	µg/L	BGCR	B	12	125	0.10	2.00	100.00	2.10	20.30	12.13	17.41	1.44
TOTAL-METALS	MOLYBDENUM	µg/L	CREEK	S	6	8	0.75	3.50	3.50	3.50	7.40	4.53	2.07	0.46
TOTAL-METALS	MOLYBDENUM	µg/L	200	S	17	19	0.89	3.50	3.50	3.60	8.20	5.08	1.61	0.32
TOTAL-METALS	MOLYBDENUM	µg/L	201	S	20	20	1.00			3.30	7.70	5.29	1.35	0.25
TOTAL-METALS	MOLYBDENUM	µg/L	202	S	5	13	0.38	1.70	2.70	1.90	4.40	1.78	1.00	0.56
TOTAL-METALS	MOLYBDENUM	µg/L	BM-LK	B		20					60.00	8.35		

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
DISSOLVED-METALS	NICKEL	µg/L	BGCR	B	4	85	0.05	3.00	40.00	6.20	21.80	7.47	5.58	0.75
DISSOLVED-METALS	NICKEL	µg/L	CREEK	S	0	3	0.00	6.00	6.00			3.00		
DISSOLVED-METALS	NICKEL	µg/L	200	S	1	16	0.06	2.60	6.00	3.50	3.50	2.18	0.92	0.42
DISSOLVED-METALS	NICKEL	µg/L	201	S	3	18	0.17	2.60	6.00	2.80	3.40	2.44	0.84	0.34
DISSOLVED-METALS	NICKEL	µg/L	202	S	2	13	0.15	2.60	6.00	2.90	6.60	2.48	1.50	0.60
DISSOLVED-METALS	NICKEL	µg/L	BM-CR	B		34		10.00			20.00			
DISSOLVED-METALS	NICKEL	µg/L	BM-LK	B		20					10.00			
TOTAL-METALS	NICKEL	µg/L	BM-LK	B		123		10.00			25.00	3.0-6.3		
TOTAL-METALS	NICKEL	µg/L	BGCR	B	15	120	0.13	3.00	40.00	3.80	12.80	7.11	5.88	0.83
TOTAL-METALS	NICKEL	µg/L	CREEK	S	1	8	0.13	2.60	11.20	2.80	2.80	3.74	1.64	0.44
TOTAL-METALS	NICKEL	µg/L	200	S	6	19	0.32	2.60	11.20	2.70	6.50	3.32	1.59	0.48
TOTAL-METALS	NICKEL	µg/L	201	S	5	20	0.25	2.60	6.00	2.80	33.10	4.18	6.89	1.65
TOTAL-METALS	NICKEL	µg/L	202	S	4	13	0.31	2.60	6.00	2.80	23.00	4.56	6.02	1.32
DISSOLVED-METALS	PHOSPHORUS	µg/L	BGCR	B	4	6	0.67	80.00	296.00	102.00	398.00	163.50	122.37	0.75
TOTAL-METALS	PHOSPHORUS	µg/L	BGCR	B	1	6	0.17	101.00	456.00	157.00	157.00	110.42	68.30	0.62
DISSOLVED-METALS	POTASSIUM	µg/L	BGCR	B	86	125	0.69	390.00	5000.00	402.00	6800.00	1612.34	1011.90	0.63
DISSOLVED-METALS	POTASSIUM	µg/L	CREEK	S	3	3	1.00			1130.00	2170.00	1626.67	521.57	0.32
DISSOLVED-METALS	POTASSIUM	µg/L	200	S	16	16	1.00			1130.00	2030.00	1559.38	181.38	0.12
DISSOLVED-METALS	POTASSIUM	µg/L	201	S	18	18	1.00			1580.00	2170.00	1858.33	122.87	0.07
DISSOLVED-METALS	POTASSIUM	µg/L	202	S	13	13	1.00			141.00	640.00	412.77	202.77	0.49
TOTAL-METALS	POTASSIUM	µg/L	BGCR	B	93	128	0.73	380.00	5000.00	493.00	6700.00	1817.03	1058.86	0.58
TOTAL-METALS	POTASSIUM	µg/L	CREEK	S	8	8	1.00			1260.00	6390.00	2611.25	1621.01	0.62
TOTAL-METALS	POTASSIUM	µg/L	200	S	19	19	1.00			1340.00	6390.00	2051.05	1105.88	0.54
TOTAL-METALS	POTASSIUM	µg/L	201	S	20	20	1.00			1260.00	2370.00	1913.50	235.85	0.12
TOTAL-METALS	POTASSIUM	µg/L	202	S	13	13	1.00			147.00	740.00	420.31	211.72	0.50
TOTAL-METALS	POTASSIUM	µg/L	BM-LK	B		35					11000.00	2150-6900		
DISSOLVED-METALS	SELENIUM	µg/L	BGCR	B	7	84	0.08	0.80	20.00	0.85	8.60	1.58	1.72	1.09
DISSOLVED-METALS	SELENIUM	µg/L	CREEK	S	1	3	0.33	3.70	3.70	3.90	3.90	2.53	1.18	0.47
DISSOLVED-METALS	SELENIUM	µg/L	200	S		16		2.90	3.80			1.71	0.20	0.12
DISSOLVED-METALS	SELENIUM	µg/L	201	S	3	18	0.17	2.80	3.90	3.00	3.90	2.05	0.75	0.37

NOTE:
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

NOTE:
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
DISSOLVED-METALS	SELENIUM	µg/L	202	S	1	13	0.08	2.90	3.80	3.00	3.00	1.64	0.43	0.26
DISSOLVED-METALS	SELENIUM	µg/L	BM-CR	B		16		5.00						
TOTAL-METALS	SELENIUM	µg/L	BM-CR	B		18		5.00						
TOTAL-METALS	SELENIUM	µg/L	BM-LK	B		103		1.00			5.00			
TOTAL-METALS	SELENIUM	µg/L	BGCR	B	7	120	0.06	0.80	20.00	0.80	6.20	1.27	1.19	0.93
TOTAL-METALS	SELENIUM	µg/L	CREEK	S	0	8	0.00	0.80	3.90			1.33	0.77	0.58
TOTAL-METALS	SELENIUM	µg/L	200	S		19		0.80	3.80			1.47	0.50	0.34
TOTAL-METALS	SELENIUM	µg/L	201	S	1	20	0.05	2.80	3.90	5.30	5.30	2.06	0.77	0.38
TOTAL-METALS	SELENIUM	µg/L	202	S		13		2.90	3.80			1.66	0.20	0.12
DISSOLVED-METALS	SILICON	µg/L	200	S	16	16	1.00			469.00	3100.00	1413.06	782.73	0.55
DISSOLVED-METALS	SILICON	µg/L	CREEK	S	3	3	1.00			1240.00	3390.00	2576.67	1166.63	0.45
DISSOLVED-METALS	SILICON	µg/L	201	S	18	18	1.00			865.00	3390.00	1459.33	619.80	0.42
DISSOLVED-METALS	SILICON	µg/L	202	S	13	13	1.00			410.00	3330.00	1476.69	1154.47	0.78
TOTAL-METALS	SILICON	µg/L	BGCR	B	67	67	1.00			690.00	15200.00	6076.23	3377.17	0.56
TOTAL-METALS	SILICON	µg/L	CREEK	S	8	8	1.00			928.00	7770.00	4097.25	2484.62	0.61
TOTAL-METALS	SILICON	µg/L	200	S	19	19	1.00			544.00	7770.00	2469.89	2107.20	0.85
TOTAL-METALS	SILICON	µg/L	201	S	20	20	1.00			928.00	4040.00	1636.95	880.01	0.54
TOTAL-METALS	SILICON	µg/L	202	S	13	13	1.00			348.00	3250.00	1345.23	1107.18	0.82
DISSOLVED-METALS	SILVER	µg/L	BGCR	B	9	98	0.09	2.00	30.00	2.60	9.20	2.75	2.72	0.99
DISSOLVED-METALS	SILVER	µg/L	CREEK	S	1	3	0.33	2.30	2.30	3.80	3.80	2.03	1.53	0.75
DISSOLVED-METALS	SILVER	µg/L	200	S	5	16	0.31	2.30	3.60	2.50	3.80	2.04	0.65	0.32
DISSOLVED-METALS	SILVER	µg/L	201	S		14		2.30	3.60			1.38	0.32	0.23
DISSOLVED-METALS	SILVER	µg/L	202	S		13		2.30	3.60			1.55	0.33	0.21
DISSOLVED-METALS	SILVER	µg/L	BM-CR	B		34		0.10			6.00			
TOTAL-METALS	SILVER	µg/L	BM-LK	B		114		0.10			3.00			
TOTAL-METALS	SILVER	µg/L	BGCR	B	14	116	0.12	2.00	10.00	2.10	7.20	2.49	1.56	
TOTAL-METALS	SILVER	µg/L	CREEK	S	0	8	0.00	2.10	3.60			1.28	0.33	
TOTAL-METALS	SILVER	µg/L	200	S		19		2.10	3.60			1.44	0.35	
TOTAL-METALS	SILVER	µg/L	201	S		16		2.30	3.60			1.43	[illegible]	
TOTAL-METALS	SILVER	µg/L	202	S		13		2.30	3.60			1.55		
DISSOLVED-METALS	SODIUM	µg/L	BGCR	B	151	152	0.99	17100.00	17100.00	4190.00	44700.00	17045.66		

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
DISSOLVED-METALS	SODIUM	µg/L	CREEK	S	3	3	1.00			5370.00	14200.00	8946.67	4647.65	0.52
DISSOLVED-METALS	SODIUM	µg/L	200	S	16	16	1.00			5370.00	8610.00	7980.00	745.48	0.09
DISSOLVED-METALS	SODIUM	µg/L	201	S	18	18	1.00			7270.00	14200.00	11770.56	1326.77	0.11
DISSOLVED-METALS	SODIUM	µg/L	202	S	13	13	1.00			27100.00	32500.00	29761.54	1875.07	0.06
TOTAL-METALS	SODIUM	µg/L	BGCR	B	154	155	0.99	5000.00	5000.00	3700.00	45400.00	16568.90	7500.07	0.45
TOTAL-METALS	SODIUM	µg/L	CREEK	S	8	8	1.00			4610.00	40000.00	12688.00	11709.00	0.92
TOTAL-METALS	SODIUM	µg/L	200	S	19	19	1.00			4610.00	40000.00	9351.05	7531.34	0.81
TOTAL-METALS	SODIUM	µg/L	201	S	20	20	1.00			6940.00	415000.00	31817.00	90201.58	2.84
TOTAL-METALS	SODIUM	µg/L	202	S	13	13	1.00			27000.00	31200.00	29076.92	1494.52	0.05
TOTAL-METALS	SODIUM	µg/L	BM-LK	B		36					54000.00	12600-54000		
DISSOLVED-METALS	STRONTIUM	µg/L	BGCR	B	112	138	0.81	100.00	1000.00	39.90	438.00	190.86	145.58	0.76
DISSOLVED-METALS	STRONTIUM	µg/L	CREEK	S	3	3	1.00			96.20	189.00	129.07	51.98	0.40
DISSOLVED-METALS	STRONTIUM	µg/L	200	S	16	16	1.00			96.20	147.00	130.45	13.03	0.10
DISSOLVED-METALS	STRONTIUM	µg/L	201	S	18	18	1.00			102.00	189.00	159.00	16.95	0.11
DISSOLVED-METALS	STRONTIUM	µg/L	202	S	13	13	1.00			114.00	137.00	124.62	7.54	0.06
TOTAL-METALS	STRONTIUM	µg/L	BGCR	B	117	135	0.87	100.00	1000.00	37.40	408.00	177.31	130.50	0.74
TOTAL-METALS	STRONTIUM	µg/L	CREEK	S	8	8	1.00			77.90	306.00	150.61	77.86	0.52
TOTAL-METALS	STRONTIUM	µg/L	200	S	19	19	1.00			77.90	306.00	135.66	45.80	0.34
TOTAL-METALS	STRONTIUM	µg/L	201	S	20	20	1.00			98.40	186.00	157.42	17.74	0.11
TOTAL-METALS	STRONTIUM	µg/L	202	S	13	13	1.00			114.00	132.00	122.69	6.01	0.05
TOTAL-METALS	STRONTIUM	µg/L	BM-LK	B		16					456.00	248.94		
DISSOLVED-METALS	THALLIUM	µg/L	BGCR	B	2	97	0.02	0.90	15.00	1.20	1.20	1.63	1.48	0.90
DISSOLVED-METALS	THALLIUM	µg/L	CREEK	S	0	3	0.00	0.90	0.90			0.45		
DISSOLVED-METALS	THALLIUM	µg/L	200	S		16		0.90	4.30			1.82	0.48	0.26
DISSOLVED-METALS	THALLIUM	µg/L	201	S		18		0.90	1.60			0.64	0.12	0.19
DISSOLVED-METALS	THALLIUM	µg/L	202	S		13		0.90	4.50			1.16	0.69	0.60
TOTAL-METALS	THALLIUM	µg/L	BGCR	B	3	124	0.02	0.60	40.00	1.60	3.40	1.68	2.15	1.28
TOTAL-METALS	THALLIUM	µg/L	CREEK	S	0	8	0.00	0.90	1.80			0.67	0.21	0.31
TOTAL-METALS	THALLIUM	µg/L	200	S		19		0.90	4.30			1.68	0.56	0.33
TOTAL-METALS	THALLIUM	µg/L	201	S		20		0.90	1.60			0.64	0.11	0.18
TOTAL-METALS	THALLIUM	µg/L	202	S		13		0.90	4.50			1.23	0.77	0.62
TOTAL-METALS	THALLIUM	µg/L	BM-LK	B		18					12.00			

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

NOTE:
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
DISSOLVED-METALS	TIN	µg/L	BGCR	B	17	98	0.17	9.30	136.00	10.80	72.40	27.74	21.15	0.76
DISSOLVED-METALS	TIN	µg/L	CREEK	S	0	3	0.00	12.50	12.50			6.25		
DISSOLVED-METALS	TIN	µg/L	200	S		16		6.20	12.50			4.48	1.61	0.36
DISSOLVED-METALS	TIN	µg/L	201	S	5	17	0.29	6.20	12.50	6.30	13.70	7.01	3.09	0.44
DISSOLVED-METALS	TIN	µg/L	202	S	1	13	0.08	6.20	12.50	8.10	8.10	4.70	1.86	0.40
TOTAL-METALS	TIN	µg/L	BGCR	B	18	118	0.15	7.00	136.00	11.00	180.00	19.61	22.01	1.12
TOTAL-METALS	TIN	µg/L	CREEK	S	0	8	0.00	6.20	12.50			4.88	1.31	0.27
TOTAL-METALS	TIN	µg/L	200	S	3	19	0.16	6.20	12.50	7.00	9.70	5.41	2.08	0.38
TOTAL-METALS	TIN	µg/L	201	S		20		6.20	12.50			4.52	1.61	0.36
TOTAL-METALS	TIN	µg/L	202	S	1	13	0.08	6.20	12.50	6.50	6.50	4.57	1.66	0.36
DISSOLVED-METALS	VANADIUM	µg/L	BGCR	B	13	106	0.12	2.00	50.00	2.00	12.10	4.20	5.55	1.32
DISSOLVED-METALS	VANADIUM	µg/L	CREEK	S	0	3	0.00	3.30	3.30			1.65	0.00	0.00
DISSOLVED-METALS	VANADIUM	µg/L	200	S	2	16	0.13	2.50	3.30	2.70	3.40	1.65	0.59	0.36
DISSOLVED-METALS	VANADIUM	µg/L	201	S		18		2.50	3.30			1.45	0.21	0.14
DISSOLVED-METALS	VANADIUM	µg/L	202	S	6	13	0.46	2.50	3.30	2.90	6.10	2.76	1.59	0.58
TOTAL-METALS	VANADIUM	µg/L	BGCR	B	33	120	0.28	2.00	60.00	2.00	18.20	6.64	8.22	1.24
TOTAL-METALS	VANADIUM	µg/L	CREEK	S	2	8	0.25	2.50	3.50	3.80	4.80	2.29	1.28	0.56
TOTAL-METALS	VANADIUM	µg/L	200	S	10	19	0.53	2.50	3.50	2.80	8.00	3.15	2.08	0.66
TOTAL-METALS	VANADIUM	µg/L	201	S	1	20	0.05	2.50	3.30	3.80	3.80	1.56	0.56	0.36
TOTAL-METALS	VANADIUM	µg/L	202	S	6	13	0.46	2.50	3.30	2.50	6.40	2.60	1.56	0.60
DISSOLVED-METALS	ZINC	µg/L	BGCR	B	86	138	0.62	1.70	44.00	2.40	111.50	14.08	18.21	1.29
DISSOLVED-METALS	ZINC	µg/L	CREEK	S	3	3	1.00			13.30	44.90	28.00	15.91	0.57
DISSOLVED-METALS	ZINC	µg/L	200	S	8	16	0.50	5.70	10.10	5.80	30.40	10.63	9.35	0.88
DISSOLVED-METALS	ZINC	µg/L	201	S	12	18	0.67	5.70	10.10	7.00	44.90	11.74	9.49	0.81
DISSOLVED-METALS	ZINC	µg/L	202	S	8	13	0.62	5.70	10.10	5.70	143.00	18.46	37.80	2.05
DISSOLVED-METALS	ZINC	µg/L	BM-CR	B		34		5.00			670.00			
DISSOLVED-METALS	ZINC	µg/L	BM-LK	B		20					20.00			
TOTAL-METALS	ZINC	µg/L	BM-LK	B		144				1.00	89.00	16.48-27		
TOTAL-METALS	ZINC	µg/L	BGCR	B	104	151	0.69	1.70	60.40	1.90	480.00	32.74	62.29	1.90
TOTAL-METALS	ZINC	µg/L	CREEK	S	8	8	1.00			15.00	158.00	91.58	59.59	0.65
TOTAL-METALS	ZINC	µg/L	200	S	19	19	1.00			13.80	158.00	48.46	44.32	0.91

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
TOTAL-METALS	ZINC	µg/L	201	S	17	20	0.85	10.10	10.10	12.80	184.00	38.60	47.49	1.23
TOTAL-METALS	ZINC	µg/L	202	S	7	13	0.54	5.70	10.10	6.60	18.00	8.18	5.49	0.67
RADIONUCLIDES														
DISSOLVED-RADS	AMERICIUM-241	pCi/L	BGCR	B	34	34	1.00			-0.010	0.500	0.070	0.129	1.83
DISSOLVED-RADS	AMERICIUM-241	pCi/L	CREEK	S	3	3	1.00			-0.002	0.003	0.001	0.003	3.77
DISSOLVED-RADS	AMERICIUM-241	pCi/L	200	S	14	14	1.00			-0.003	0.018	0.004	0.005	1.56
DISSOLVED-RADS	AMERICIUM-241	pCi/L	201	S	14	14	1.00			-0.004	0.013	0.003	0.005	1.39
DISSOLVED-RADS	AMERICIUM-241	pCi/L	202	S	12	12	1.00			-0.019	0.116	0.013	0.034	2.63
TOTAL-RADS	AMERICIUM-241	pCi/L	BGCR	B	106	106	1.00			-0.021	0.038	0.004	0.008	1.93
TOTAL-RADS	AMERICIUM-241	pCi/L	BM-LK	B		48					0.117	(-)0.013-0.019		
TOTAL-RADS	AMERICIUM-241	pCi/L	CREEK	S	5	5	1.00			-0.001	0.007	0.004	0.003	0.78
TOTAL-RADS	AMERICIUM-241	pCi/L	200	S	16	16	1.00			-0.005	0.017	0.005	0.005	1.00
TOTAL-RADS	AMERICIUM-241	pCi/L	201	S	17	17	1.00			-0.001	0.026	0.006	0.007	1.04
TOTAL-RADS	AMERICIUM-241	pCi/L	202	S	12	12	1.00			0.000	0.017	0.006	0.005	0.86
DISSOLVED-RADS	GROSS ALPHA	pCi/L	BGCR	B	60	60	1.00			-1.380	5.000	0.687	1.123	1.63
DISSOLVED-RADS	GROSS ALPHA	pCi/L	200	S	16	16	1.00			-0.420	2.700	0.485	0.716	1.48
DISSOLVED-RADS	GROSS ALPHA	pCi/L	201	S	15	15	1.00			-0.580	1.400	0.782	0.473	0.60
DISSOLVED-RADS	GROSS ALPHA	pCi/L	202	S	12	12	1.00			-0.130	1.900	0.496	0.545	1.10
TOTAL-RADS	GROSS ALPHA	pCi/L	BGCR	B	85	85	1.00			-2.000	13.000	1.513	2.238	1.48
TOTAL-RADS	GROSS ALPHA	pCi/L	200	S	15	15	1.00			0.072	2.200	1.124	0.727	0.65
TOTAL-RADS	GROSS ALPHA	pCi/L	201	S	15	15	1.00			0.440	1.900	1.178	0.489	0.41
TOTAL-RADS	GROSS ALPHA	pCi/L	202	S	11	11	1.00			-0.250	1.200	0.520	0.445	0.86
DISSOLVED-RADS	GROSS BETA	pCi/L	BGCR	B	61	61	1.00			-0.676	41.820	4.687	6.777	1.45
DISSOLVED-RADS	GROSS BETA	pCi/L	200	S	16	16	1.00			0.080	2.900	1.621	0.831	0.51
DISSOLVED-RADS	GROSS BETA	pCi/L	201	S	15	15	1.00			-0.140	4.300	1.955	1.025	0.52
DISSOLVED-RADS	GROSS BETA	pCi/L	202	S	12	12	1.00			-0.250	2.100	0.762	0.735	0.96
TOTAL-RADS	GROSS BETA	pCi/L	BGCR	B	82	82	1.00			-0.400	36.000	4.552	5.520	1.21
TOTAL-RADS	GROSS BETA	pCi/L	200	S	18	18	1.00			0.270	4.700	2.776	1.304	0.47
TOTAL-RADS	GROSS BETA	pCi/L	201	S	20	20	1.00			-0.010	4.300	2.177	1.108	0.51
TOTAL-RADS	GROSS BETA	pCi/L	202	S	13	13	1.00			-2.100	3.000	0.821	1.421	1.73

TABLE B-3

COMPARISON TO BENCHMARK DATA--SURFACE WATER

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
NOTE:														
BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))														
BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))														
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	BGCR	B	36	36	1.00			-0.123	0.900	0.116	0.204	1.76
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	BM-LK	B		55					0.206	0.004-0.016		
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	CREEK	S	2	2	1.00			0.004	0.006	0.005	0.001	0.28
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	200	S	9	9	1.00			-0.003	0.002	0.000	0.002	-7.82
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	201	S	13	13	1.00			-0.002	0.009	0.002	0.003	1.30
DISSOLVED-RADS	PLUTONIUM-239/240	pCi/L	202	S	10	10	1.00			-0.001	0.003	0.001	0.001	1.91
TOTAL-RADS	PLUTONIUM-239/240	pCi/L	BGCR	B	105	105	1.00			-0.016	0.048	0.004	0.008	1.96
TOTAL-RADS	PLUTONIUM-239/240	pCi/L	CREEK	S	7	7	1.00			-0.001	0.001	0.000	0.001	2.65
TOTAL-RADS	PLUTONIUM-239/240	pCi/L	200	S	13	13	1.00			-0.001	0.005	0.002	0.002	0.80
TOTAL-RADS	PLUTONIUM-239/240	pCi/L	201	S	19	19	1.00			0.000	0.009	0.002	0.002	1.08
TOTAL-RADS	PLUTONIUM-239/240	pCi/L	202	S	12	12	1.00			-0.005	0.030	0.005	0.010	1.84
TOTAL-RADS	TRITIUM	pCi/L	BGCR	B	73	73	1.00			-800.000	751.000	75.705	209.217	2.76
TOTAL-RADS	TRITIUM	pCi/L	BM-LK	B		60					147.000	(-)19-147		
TOTAL-RADS	TRITIUM	pCi/L	200	S	5	5	1.00			-29.100	144.300	47.776	83.228	1.74
DISSOLVED-RADS	URANIUM-233/234	pCi/L	BGCR	B	55	55	1.00			-0.016	1.800	0.359	0.365	1.01
DISSOLVED-RADS	URANIUM-233/234	pCi/L	CREEK	S	2	2	1.00			0.480	0.480	0.480		
DISSOLVED-RADS	URANIUM-233/234	pCi/L	200	S	12	12	1.00			0.140	0.560	0.418	0.124	0.30
DISSOLVED-RADS	URANIUM-233/234	pCi/L	201	S	12	12	1.00			0.430	1.200	0.741	0.227	0.31
DISSOLVED-RADS	URANIUM-233/234	pCi/L	202	S	10	10	1.00			0.170	0.699	0.350	0.182	0.52
TOTAL-RADS	URANIUM-233/234	pCi/L	BGCR	B	79	79	1.00			-0.007	3.213	0.486	0.550	1.13
TOTAL-RADS	URANIUM-233/234	pCi/L	BM-LK	B		56					2.100	0.32-1.3		
TOTAL-RADS	URANIUM-233/234	pCi/L	CREEK	S	6	6	1.00			0.078	1.273	0.693	0.532	0.77
TOTAL-RADS	URANIUM-233/234	pCi/L	200	S	12	12	1.00			0.190	1.200	0.609	0.313	0.51
TOTAL-RADS	URANIUM-233/234	pCi/L	201	S	20	20	1.00			0.078	1.300	0.749	0.354	0.47
TOTAL-RADS	URANIUM-233/234	pCi/L	202	S	13	13	1.00			0.080	0.820	0.388	0.238	0.61
DISSOLVED-RADS	URANIUM-235	pCi/L	BGCR	B	56	56	1.00			-0.018	0.895	0.140	0.203	1.45
DISSOLVED-RADS	URANIUM-235	pCi/L	CREEK	S	2	2	1.00			0.000	0.310	0.155	0.219	1.41
DISSOLVED-RADS	URANIUM-235	pCi/L	200	S	12	12	1.00			-0.081	0.510	0.072	0.168	2.33
DISSOLVED-RADS	URANIUM-235	pCi/L	201	S	12	12	1.00			-0.004	0.710	0.146	0.257	1.76
DISSOLVED-RADS	URANIUM-235	pCi/L	202	S	10	10	1.00			-0.198	0.140	0.020	0.094	4.73
TOTAL-RADS	URANIUM-235	pCi/L	BGCR	B	75	75	1.00			-0.030	0.376	0.049	0.075	1.52

TABLE B-3

COMPARISON TO BENCHMARK DATA–SURFACE WATER

NOTE:

BM-CR = Benchmark Stream Values (Ralston Creek, Croke Canal, Farmer's Highline canal (Arvada, 1994))

BM-LK = Benchmark Lakes/Reservoir Values (Chatfield Reservoir, Cherry Creek, Bear Creek Lake, and Harriman Lake (Arvada, 1994; EPA, 1993 and 1994))

Main Test Group Code	Chemical Name	New Unit	Data Source	Area	Number of Detects	Number of Samples	Frequency of Detection	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected value	Maximum Detected Value	Mean*	Standard Deviation	Coefficient of Variation
TOTAL-RADS	URANIUM-235	pCi/L	BM-LK	B		8					0.100			
TOTAL-RADS	URANIUM-235	pCi/L	CREEK	S	6	6	1.00			0.000	0.170	0.081	0.075	0.92
TOTAL-RADS	URANIUM-235	pCi/L	200	S	12	12	1.00			-0.039	0.410	0.082	0.125	1.53
TOTAL-RADS	URANIUM-235	pCi/L	201	S	20	20	1.00			-0.021	0.270	0.070	0.074	1.06
TOTAL-RADS	URANIUM-235	pCi/L	202	S	13	13	1.00			-0.028	0.145	0.032	0.059	1.83
DISSOLVED-RADS	URANIUM-238	pCi/L	BGCR	B	55	55	1.00			0.000	1.700	0.277	0.270	0.98
DISSOLVED-RADS	URANIUM-238	pCi/L	BM-LK	B	10						2.000	0.910		
DISSOLVED-RADS	URANIUM-238	pCi/L	CREEK	S	2	2	1.00			0.380	0.410	0.395	0.021	0.05
DISSOLVED-RADS	URANIUM-238	pCi/L	200	S	12	12	1.00			-0.046	0.580	0.296	0.186	0.63
DISSOLVED-RADS	URANIUM-238	pCi/L	201	S	12	12	1.00			-0.043	0.730	0.408	0.236	0.58
DISSOLVED-RADS	URANIUM-238	pCi/L	202	S	10	10	1.00			-0.255	0.420	0.135	0.193	1.43
TOTAL-RADS	URANIUM-238	pCi/L	BGCR	B	55	55	1.00			0.000	1.820	0.364	0.432	1.18
TOTAL-RADS	URANIUM-238	pCi/L	BM-LK	B		56					5.500	0.28-1.49		
TOTAL-RADS	URANIUM-238	pCi/L	CREEK	S	6	6	1.00			-0.022	0.870	0.524	0.333	0.64
TOTAL-RADS	URANIUM-238	pCi/L	200	S	12	12	1.00			-0.024	0.870	0.433	0.225	0.52
TOTAL-RADS	URANIUM-238	pCi/L	201	S	20	20	1.00			-0.022	1.100	0.618	0.292	0.47
TOTAL-RADS	URANIUM-238	pCi/L	202	S	12	12	1.00			0.091	0.650	0.285	0.168	0.59

*For benchmark data, range of means is presented.
B = Background.
BGCR = Background Geochemical Characterization Report (1993c).
S = OU 3 (onsite).

Table B-4
Comparison to Benchmark Data--Groundwater

Well No.	Test Group	Parameter	Unit	No. of Detects	No. of Samples	Freq. of Detect	Min. Nondetect	Max. Nondetect	Max. Nondetect	Min. Detect	Max. Detect	Arith. Mean	Stand. Dev.	m + 2s	Upper Geo Chem. Min	Upper Geo Chem Max	Upper Geo. Chem. Mean	Std. Dev.	Mean Plus 2 SD	Min Lower Geo	Max Lower Geo	Mean Lower Geo	Std. Dev.	Mean Plus 2 SD	Min (Dragun)	Max (Dragun)	Standard (1)
49192	DMETAL	ALUMINUM	ug/L	1	8	0.13	13.0	40.0	20	47.1	47.1	16.231	13.249	42.730	2.5	1036	59.52	87.29	234.1	3	256	48.81	44.02	136.85	<5	1000	5000 (ag)
49292	DMETAL	ALUMINUM	ug/L		8		13.0	40.0	20					0.000	2.5	1036	59.52	87.29	234.1	3	256	48.81	44.02	136.85	<5	1000	5000 (ag)
49192	TMETAL	ALUMINUM	ug/L	8	8	1.00				965	23400	8499.375	9254.575	27008.525	22.6	19950	2742.8	4248.73	11240	11	11700	1792	2773.43	7338.86	<5	1000	
49292	TMETAL	ALUMINUM	ug/L	5	8	0.63	24.1	46.8	23.4	28.2	338	72.019	108.713	289.445	22.6	19950	2742.8	4248.73	11240	11	11700	1792	2773.43	7338.86	<5	1000	
49192	TRADS	AMERICIUM-241	pCi/L	7	7	1.00				0	0.021	0.007	0.008	0.023	-0.01	0.1	0.01	0.01	0.03	0	0.1	0.01	0.02	0.05			
49292	TRADS	AMERICIUM-241	pCi/L	7	7	1.00				0.001214	0.01	0.005	0.003	0.011	-0.01	0.1	0.01	0.01	0.03	0	0.1	0.01	0.02	0.05			
49192	DMETAL	ANTIMONY	ug/L	2	8	0.25	13.0	36.0	18	17.3	89.8	22.013	27.836	77.685	3	54.1	17.34	11.1	39.54	4	35.65	15.5	9.17	33.84			
49292	DMETAL	ANTIMONY	ug/L		8		13.0	36.0	18					0.000	3	54.1	17.34	11.1	39.54	4	35.65	15.5	9.17	33.84			
49192	TMETAL	ANTIMONY	ug/L	1	8	0.13	13.0	36.0	18	27.5	27.5	12.750	7.231	27.212	3.6	86.6	19.19	12.85	44.89	3.5	41.3	15.62	10.4	36.42			
49292	TMETAL	ANTIMONY	ug/L		8		13.0	36.0	18					0.000	3.6	86.6	19.19	12.85	44.89	3.5	41.3	15.62	10.4	36.42			
49192	DMETAL	ARSENIC	ug/L	1	8	0.13	1.0	3.0	1.5	1	1	0.813	0.372	1.557	0.4	15	1.63	1.84	5.31	0.4	6.2	2.41	1.7	5.81	<1	30	50 (dw)
49292	DMETAL	ARSENIC	ug/L	6	8	0.75	2.0	3.0	1.5	2	25	5.138	8.070	21.278	0.4	15	1.63	1.84	5.31	0.4	6.2	2.41	1.7	5.81	<1	30	50 (dw)
49192	TMETAL	ARSENIC	ug/L	5	8	0.63	1.7	3.0	1.5	2.3	6.9	2.994	2.130	7.253	0.35	5	1.95	1.71	5.37	0.35	7	2.76	2.02	6.8	<1	30	
49292	TMETAL	ARSENIC	ug/L	5	8	0.63	2.0	3.0	1.5	2.7	3.8	2.525	1.071	4.668	0.35	5	1.95	1.71	5.37	0.35	7	2.76	2.02	6.8	<1	30	
49192	DMETAL	BARIUM	ug/L	6	8	0.75	16.0	23.0	11.5	24.2	55	28.838	15.310	59.458	14.75	203	83.42	34.56	152.54	34.8	132.5	84.18	21.79	127.76	10	500	1000 (dw)
49292	DMETAL	BARIUM	ug/L	7	8	0.88	16.0	16.0	8	29.3	35	28.625	8.504	45.633	14.75	203	83.42	34.56	152.54	34.8	132.5	84.18	21.79	127.76	10	500	1000 (dw)
49192	TMETAL	BARIUM	ug/L	8	8	1.00				34.8	166	80.300	59.329	198.957	25.9	317	102.44	45.37	193.18	61.5	303	113.95	51.97	217.89	10	500	
49292	TMETAL	BARIUM	ug/L	8	8	1.00				29.3	38.5	32.913	3.323	39.558	25.9	317	102.44	45.37	193.18	61.5	303	113.95	51.97	217.89	10	500	
49192	DMETAL	BERYLLIUM	ug/L		8		1.0	1.0	0.5					0.000	0.15	4	1.01	0.83	2.67	0.3	2.5	0.9	0.73	2.36	<10	10	
49292	DMETAL	BERYLLIUM	ug/L		8		1.0	1.0	0.5					0.000	0.15	4	1.01	0.83	2.67	0.3	2.5	0.9	0.73	2.36	<10	10	
49192	TMETAL	BERYLLIUM	ug/L	4	8	0.50	1.0	1.0	0.5	1.1	1.6	0.913	0.473	1.859	0.4	4.8	1.07	0.87	2.81	0.3	2.5	0.86	0.74	2.34	<10	10	
49292	TMETAL	BERYLLIUM	ug/L		8		1.0	1.0	0.5					0.000	0.4	4.8	1.07	0.87	2.81	0.3	2.5	0.86	0.74	2.34	<10	10	
49192	DMETAL	CADMIUM	ug/L		8		2.0	4.0	2					0.000	0.5	8.6	1.73	1.26	4.25	0.5	7.5	1.76	1.33	4.42	<1	1	
49292	DMETAL	CADMIUM	ug/L		8		2.0	4.0	2					0.000	0.5	8.6	1.73	1.26	4.25	0.5	7.5	1.76	1.33	4.42	<1	1	
49192	TMETAL	CADMIUM	ug/L	1	8	0.13	2.0	4.0	2	2.8	2.8	1.663	0.595	2.853	0.5	11.1	1.64	1.29	4.22	0.5	3.5	1.45	0.75	2.95	<1	1	
49292	TMETAL	CADMIUM	ug/L		8		2.0	4.0	2					0.000	0.5	11.1	1.64	1.29	4.22	0.5	3.5	1.45	0.75	2.95	<1	1	
49192	DMETAL	CALCIUM	ug/L	8	8	1.00				267000	4E+05	313375.000	26597.194	366569.387	15150	184000	55414.55	32564.11	120543	8190	79400	34535.82	23552.79	81641.4	<500000	500000	
49292	DMETAL	CALCIUM	ug/L	8	8	1.00				84900	98100	88312.500	4348.542	97009.585	15150	184000	55414.55	32564.11	120543	8190	79400	34535.82	23552.79	81641.4	<500000	500000	
49192	TMETAL	CALCIUM	ug/L	8	8	1.00				273000	4E+05	314250.000	26762.160	367774.360	15950	186000	55030.23	31667.78	118366	10800	91900	36382	23881.47	84144.94	<500000	500000	
49292	TMETAL	CALCIUM	ug/L	8	8	1.00				82200	99100	88975.000	5312.989	99600.979	15950	186000	55030.23	31667.78	118366	10800	91900	36382	23881.47	84144.94	<500000	500000	
49192	DMETAL	CESIUM	ug/L	2	5	0.40	12.0	36.0	18	26	38	20.500	12.135	44.769	2	2500	202.2	285.69	773.58	2	500	160.88	179.94	520.76			
49292	DMETAL	CESIUM	ug/L	2	6	0.33	12.0	36.0	18	19	41	18.500	11.958	42.417	2	2500	202.2	285.69	773.58	2	500	160.88	179.94	520.76			
49192	TMETAL	CESIUM	ug/L	2	8	0.25	12.0	50.0	25	25	50	19.938	14.216	48.370	2	500	154.42	198.79	552	2	500	131.59	175.16	481.91			
49292	TMETAL	CESIUM	ug/L		5		12.0	36.0	18					0.000	2	500	154.42	198.79	552	2	500	131.59	175.16	481.91			
49192	DMETAL	CHROMIUM	ug/L		8		2.0	4.0	2					0.000	1	23.2	4.84	3.8	12.44	1	15.5	3.97	3.15	10.27	<1	5	
49292	DMETAL	CHROMIUM	ug/L		8		2.0	4.0	2					0.000	1	23.2	4.84	3.8	12.44	1	15.5	3.97	3.15	10.27	<1	5	
49192	TMETAL	CHROMIUM	ug/L	5	8	0.63	4.0	5.2	2.6	3.7	29	11.038	11.048	33.134	1	31.65	7.01	6.68	20.37	1	21.4	5.25	4.61	14.47	<1	5	

Table B-4
Comparison to Benchmark Data--Groundwater

Well No.	Test Group	Parameter	Unit	No. of Detects	No. of Samples	Freq. of Detect	Min. Nondetect	Max. Nondetect	Max. Nondetect	Min. Detect	Max. Detect	Arith. Mean	Stand. Dev.	m + 2s	Upper Geo Chem. Min	Upper Geo Chem Max	Upper Geo. Chem, Mean	Std. Dev.	Mean Plus 2 SD	Min Lower Geo	Max Lower Geo	Mean Lower Geo	Std. Dev.	Mean Plus 2 SD	Min (Dragun)	Max (Dragun)	Standard (1)
49292	TMETAL	CHROMIUM	ug/L	1	8	0.13	3.0	4.0	2	2.5	2.5	1.813	0.372	2.557	1	31.65	7.01	6.68	20.37	1	21.4	5.25	4.61	14.47	<1	5	
49192	DMETAL	COBALT	ug/L		8		3.0	6.0	3					0.000	1	29	6.6	9.04	24.68	1	25	5.16	7.88	20.92	<10	10	
49292	DMETAL	COBALT	ug/L		8		3.0	6.0	3					0.000	1	29	6.6	9.04	24.68	1	25	5.16	7.88	20.92	<10	10	
49192	TMETAL	COBALT	ug/L	4	8	0.50	3.0	6.0	3	5.3	16.6	6.400	5.665	17.730	1	39.4	7.64	9.67	26.98	1	25	5.55	8.18	21.91	<10	10	
49292	TMETAL	COBALT	ug/L		8		3.0	6.0	3					0.000	1	39.4	7.64	9.67	26.98	1	25	5.55	8.18	21.91	<10	10	
49192	DMETAL	COPPER	ug/L	2	8	0.25	2.0	4.0	2	3	3.8	1.850	1.073	3.996	0.5	20.9	5.01	4.42	13.85	0.5	12.5	4.17	3.83	11.83	<1	30	1000(sec)
49292	DMETAL	COPPER	ug/L	1	8	0.13	2.0	4.0	2	2.7	2.7	1.463	0.674	2.810	0.5	20.9	5.01	4.42	13.85	0.5	12.5	4.17	3.83	11.83	<1	30	1000(sec)
49192	TMETAL	COPPER	ug/L	8	8	1.00				4.8	39.7	16.350	13.776	43.901	1	105	10.67	12.21	35.09	1	125	11.99	21.82	55.63	<1	30	
49292	TMETAL	COPPER	ug/L	2	8	0.25	2.0	4.0	2	4.4	4.9	2.038	1.654	5.346	1	105	10.67	12.21	35.09	1	125	11.99	21.82	55.63	<1	30	
49192	DMETAL	IRON	ug/L	6	7	0.86	3.2	3.2	1.6	50.9	464	262.071	179.968	622.008	1	1106.5	56.26	113.44	283.14	1.5	181	33.67	35.32	104.31	10	10000	300 (sec)
49292	DMETAL	IRON	ug/L	8	8	1.00				498	715	617.625	78.249	774.122	1	1106.5	56.26	113.44	283.14	1.5	181	33.67	35.32	104.31	10	10000	300 (sec)
49192	TMETAL	IRON	ug/L	8	8	1.00				2210	27100	11575.000	11442.736	34460.471	6.5	27100	3017.34	4994.5	13006	9.8	16900	2239.92	3697.44	9634.8	10	10000	
49292	TMETAL	IRON	ug/L	8	8	1.00				753	1300	898.500	174.585	1247.670	6.5	27100	3017.34	4994.5	13006	9.8	16900	2239.92	3697.44	9634.8	10	10000	
49192	DMETAL	LEAD	ug/L	1	8	0.13	1.0	2.0	1	2.6	2.6	0.888	0.728	2.343	0.2	64	1.59	4.71	11.01	0.4	41.6	1.8	5.27	12.34	<15	15	50 (dw)
49292	DMETAL	LEAD	ug/L	1	8	0.13	1.0	2.0	1	5.8	5.8	1.288	1.837	4.962	0.2	64	1.59	4.71	11.01	0.4	41.6	1.8	5.27	12.34	<15	15	50 (dw)
49192	TMETAL	LEAD	ug/L	7	8	0.88	2.0	2.0	1	1.8	20.1	7.888	7.722	23.332	0.5	25	3.26	3.64	10.54	0.5	17.7	3.82	4.29	12.4	<15	15	
49292	TMETAL	LEAD	ug/L	1	8	0.13	1.0	2.0	1	1.7	1.7	0.775	0.437	1.648	0.5	25	3.26	3.64	10.54	0.5	17.7	3.82	4.29	12.4	<15	15	
49192	DMETAL	LITHIUM	ug/L	8	8	1.00				346	483	420.375	49.814	520.003	0.5	250	33.95	54.3	142.55	2	104	38.53	27.84	94.21	1	150	2500 (ag)
49292	DMETAL	LITHIUM	ug/L	8	8	1.00				67.8	81.4	75.675	4.722	85.119	0.5	250	33.95	54.3	142.55	2	104	38.53	27.84	94.21	1	150	2500 (ag)
49192	TMETAL	LITHIUM	ug/L	8	8	1.00				349	465	420.500	38.998	498.496	1.1	266	33.75	48.76	131.27	6.2	106	40.69	29.29	99.27	1	150	
49292	TMETAL	LITHIUM	ug/L	8	8	1.00				72.2	78.6	74.850	2.056	78.961	1.1	266	33.75	48.76	131.27	6.2	106	40.69	29.29	99.27	1	150	
49192	DMETAL	MAGNESIUM	ug/L	8	8	1.00				51200	88400	78587.500	11892.908	102373.315	2120	46300	10038.28	8309	26656	1720	16400	6072.16	4067.56	14207.28	<400000	400000	
49292	DMETAL	MAGNESIUM	ug/L	8	8	1.00				21200	23800	22000.000	858.570	23717.140	2120	46300	10038.28	8309	26656	1720	16400	6072.16	4067.56	14207.28	<400000	400000	
49192	TMETAL	MAGNESIUM	ug/L	8	8	1.00				55300	97700	80487.500	12075.292	104638.084	2230	47900	10315.64	7956.43	26229	1950	19700	6679.46	5030.81	16741.08	<400000	400000	
49292	TMETAL	MAGNESIUM	ug/L	8	8	1.00				20700	24300	22087.500	1133.185	24353.869	2230	47900	10315.64	7956.43	26229	1950	19700	6679.46	5030.81	16741.08	<400000	400000	
49192	DMETAL	MANGANESE	ug/L	8	8	1.00				187	377	293.250	59.341	411.932	0.5	440	27.47	67.43	162.33	0.5	30.2	9.29	7.24	23.77	<1	1000	50 (sec)
49292	DMETAL	MANGANESE	ug/L	8	8	1.00				53.2	64.9	58.800	4.920	68.640	0.5	440	27.47	67.43	162.33	0.5	30.2	9.29	7.24	23.77	<1	1000	50 (sec)
49192	TMETAL	MANGANESE	ug/L	8	8	1.00				327	959	485.250	227.264	939.779	0.5	584	79.59	108.18	295.95	1	710	61.87	125.21	312.29	<1	1000	
49292	TMETAL	MANGANESE	ug/L	8	8	1.00				52.8	70.2	60.113	5.717	71.546	0.5	584	79.59	108.18	295.95	1	710	61.87	125.21	312.29	<1	1000	
49192	DMETAL	MERCURY	ug/L		8		0.2	0.2	0.1					0.000	0.05	0.69	0.11	0.07	0.25	0.05	1.2	0.13	0.15	0.43			
49292	DMETAL	MERCURY	ug/L		8		0.2	0.2	0.1					0.000	0.05	0.69	0.11	0.07	0.25	0.05	1.2	0.13	0.15	0.43			
49192	TMETAL	MERCURY	ug/L		8		0.2	0.2	0.1					0.000	0.1	0.27	0.12	0.04	0.2	0.1	0.24	0.13	0.05	0.23			
49292	TMETAL	MERCURY	ug/L		8		0.2	0.2	0.1					0.000	0.1	0.27	0.12	0.04	0.2	0.1	0.24	0.13	0.05	0.23			
49192	DMETAL	MOLYBDENUM	ug/L	1	8	0.13	4.0	15.0	7.5	9.8	9.8	4.663	2.913	10.488	1	114	19.64	33.94	87.52	1	100	16.86	27.01	70.88	<1	30	100 (ag)
49292	DMETAL	MOLYBDENUM	ug/L	1	8	0.13	4.0	15.0	7.5	5.1	5.1	4.163	1.998	8.158	1	114	19.64	33.94	87.52	1	100	16.86	27.01	70.88	<1	30	100 (ag)
49192	TMETAL	MOLYBDENUM	ug/L		8		5.0	16.0	8					0.000	1	100	24.09	39.47	103.03	1	100	18.59	33.45	85.49	<1	30	
49292	TMETAL	MOLYBDENUM	ug/L	1	8	0.13	4.0	15.0	7.5	10.2	10.2	5.200	2.673	10.546	1	100	24.09	39.47	103.03	1	100	18.59	33.45	85.49	<1	30	

Table B-4
Comparison to Benchmark Data--Groundwater

Well No.	Test Group	Parameter	Unit	No. of Detects	No. of Samples	Freq. of Detect	Min. Nondetect	Max. Nondetect	Max. Nondetect	Min. Detect	Max. Detect	Arith. Mean	Stand. Dev.	m + 2s	Upper Geo Chem. Min	Upper Geo Chem Max	Upper Geo. Chem. Mean	Std. Dev.	Mean Plus 2 SD	Min Lower Geo	Max Lower Geo	Mean Lower Geo	Std. Dev.	Mean Plus 2 SD	Min (Dragun)	Max (Dragun)	Standard (1)
49192	DMETAL	NICKEL	ug/L	1	8	0.13	5.0	14.0	7	9.6	9.6	4.888	2.444	9.775	1	35.8	7.01	7.18	21.37	1	20	5.81	6.26	18.33	<10	50	200 (ag)
49292	DMETAL	NICKEL	ug/L		8		5.0	14.0	7					0.000	1	35.8	7.01	7.18	21.37	1	20	5.81	6.26	18.33	<10	50	200 (ag)
49192	TMETAL	NICKEL	ug/L	2	8	0.25	6.0	33.1	16.6	24	30.3	11.669	10.633	32.935	1	71.6	10.58	9.49	29.56	1	24.5	8.7	7.25	23.2	<10	50	
a150	TMETAL	NICKEL	ug/L		8		5.0	14.0	7					0.000	1	71.6	10.58	9.49	29.56	1	24.5	8.7	7.25	23.2	<10	50	
49192	TRADS	PLUTONIUM-239/240	pCi/L	7	7	1.00				-0.013	0.085	0.011	0.033	0.078	-0.01	0.22	0	0.02	0.04	0	0.05	0	0.01	0.02			
49292	TRADS	PLUTONIUM-239/240	pCi/L	7	7	1.00				-0.00101	0.001	0.000	0.001	0.002	-0.01	0.22	0	0.02	0.04	0	0.05	0	0.01	0.02			
49192	DMETAL	POTASSIUM	ug/L	8	8	1.00				8890	11300	10090.000	871.452	11832.904	160	8110	1371.5	1069.01	3509.5	366	5800	2731.18	1612.39	5955.96	1000	10000	
49292	DMETAL	POTASSIUM	ug/L	8	8	1.00				2890	4020	3575.000	386.153	4347.306	160	8110	1371.5	1069.01	3509.5	366	5800	2731.18	1612.39	5955.96	1000	10000	
49192	TMETAL	POTASSIUM	ug/L	8	8	1.00				10200	14800	11925.000	1737.609	15400.218	243	8370	1731.21	1176.59	4084.4	516	6870	2846.38	1725.69	6297.76	1000	10000	
49292	TMETAL	POTASSIUM	ug/L	7	8	0.88	4090.0	4090.0	2045	3210	3830	3430.625	597.151	4624.926	243	8370	1731.21	1176.59	4084.4	516	6870	2846.38	1725.69	6297.76	1000	10000	
49292	DRAD	RADIUM-226	pCi/L	1	1	1.00	0.0	0.0		0.7	0.7	0.700		0.700	0.06	0.53	0.26	0.11	0.48	0.47	2.98	1.72	1.78	5.28			
49192	DMETAL	SELENIUM	ug/L		8		1.0	3.0	1.5					0.000	0.5	173	5.58	19.07	43.72	0.5	6	1.34	1.09	3.52	<1	10	10 (dw)
49292	DMETAL	SELENIUM	ug/L	1	8	0.13	1.0	3.0	1.5	1.5	1.5	0.969	0.388	1.745	0.5	173	5.58	19.07	43.72	0.5	6	1.34	1.09	3.52	<1	10	10 (dw)
49192	TMETAL	SELENIUM	ug/L	2	8	0.25	1.0	10.0	5	1.6	1.6	2.150	1.798	5.747	0.5	203	4.57	18.64	41.85	0.5	2.5	1.19	0.63	2.45	<1	10	
49292	TMETAL	SELENIUM	ug/L		8		1.0	3.0	1.5					0.000	0.5	203	4.57	18.64	41.85	0.5	2.5	1.19	0.63	2.45	<1	10	
49192	DMETAL	SILICON	ug/L	8	8	1.00				5840	6700	6355.000	276.922	6908.844	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5000	100000	
49292	DMETAL	SILICON	ug/L	8	8	1.00				4760	5510	5267.500	233.162	5733.823	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5000	100000	
49192	TMETAL	SILICON	ug/L	8	8	1.00				8140	53600	23485.000	18505.896	60496.793	4399	51650	15564.97	10797.33	37160	3720	29500	9427.5	6631.12	22689.74	5000	100000	
49292	TMETAL	SILICON	ug/L	8	8	1.00				5110	6260	5535.000	432.633	6400.266	4399	51650	15564.97	10797.33	37160	3720	29500	9427.5	6631.12	22689.74	5000	100000	
49192	DMETAL	SILVER	ug/L	1	8	0.13	3.0	13.0	6.5	6.4	6.4	2.800	2.260	7.319	1	11.8	2.84	2.12	7.08	1	9.4	2.69	2.01	6.71	<5	5	50 (dw)
49292	DMETAL	SILVER	ug/L		8		3.0	13.0	6.5					0.000	1	11.8	2.84	2.12	7.08	1	9.4	2.69	2.01	6.71	<5	5	50 (dw)
49192	TMETAL	SILVER	ug/L		8		3.0	5.0	2.5					0.000	1	10	2.35	1.8	5.95	1	10	2.19	2.03	6.25	<5	5	
49292	TMETAL	SILVER	ug/L		8		3.0	5.0	2.5					0.000	1	10	2.35	1.8	5.95	1	10	2.19	2.03	6.25	<5	5	
49192	DMETAL	SODIUM	ug/L	8	8	1.00				425000	6E+05	497000.000	39122.518	575245.036	2500	252000	32012.98	43667.67	119348	11000	452000	142012.7	135521.6	413055.81	<1000000	1000000	
49292	DMETAL	SODIUM	ug/L	8	8	1.00				243000	3E+05	262500.000	10915.258	284330.516	2500	252000	32012.98	43667.67	119348	11000	452000	142012.7	135521.6	413055.81	<1000000	1000000	
49192	TMETAL	SODIUM	ug/L	8	8	1.00				403000	5E+05	488000.000	40482.801	568965.601	2500	194000	30081.85	40019.71	110121	11500	434000	139228	134404.3	408036.66	<1000000	1000000	
49292	TMETAL	SODIUM	ug/L	8	8	1.00				258000	3E+05	262875.000	3642.507	270160.014	2500	194000	30081.85	40019.71	110121	11500	434000	139228	134404.3	408036.66	<1000000	1000000	
49192	DMETAL	STRONTIUM	ug/L	8	8	1.00				3860	5390	4892.500	483.876	5860.251	50	1910	323.6	303.58	930.76	89.5	1140	383.02	294.27	971.56	100	4000	
49292	DMETAL	STRONTIUM	ug/L	8	8	1.00				1090	1290	1163.750	60.695	1285.141	50	1910	323.6	303.58	930.76	89.5	1140	383.02	294.27	971.56	100	4000	
49192	TMETAL	STRONTIUM	ug/L	8	8	1.00				3860	5590	4873.750	495.723	5865.196	58.1	1770	312.61	271.09	854.79	100	1170	399.78	312.58	1024.94	100	4000	
49292	TMETAL	STRONTIUM	ug/L	8	8	1.00				1090	1280	1160.000	71.114	1302.227	58.1	1770	312.61	271.09	854.79	100	1170	399.78	312.58	1024.94	100	4000	
49192	DMETAL	THALLIUM	ug/L		8		1.0	4.0	2					0.000	0.3	5	1.64	1.63	4.9	0.3	10	1.72	1.87	5.46			
49292	DMETAL	THALLIUM	ug/L	1	8	0.13	1.0	4.0	2	1.2	1.2	1.025	0.602	2.229	0.3	5	1.64	1.63	4.9	0.3	10	1.72	1.87	5.46			
49192	TMETAL	THALLIUM	ug/L		8		1.0	4.0	2					0.000	0.45	5	1.67	1.76	5.19	0.45	5	1.4	1.5	4.4			
49292	TMETAL	THALLIUM	ug/L		8		1.0	4.0	2					0.000	0.45	5	1.67	1.76	5.19	0.45	5	1.4	1.5	4.4			
49192	DMETAL	TIN	ug/L	3	8	0.38	10.0	13.0	6.5	36.9	46.1	19.150	18.463	56.077	2	340	30.96	37.34	105.64	4.7	100	23.07	25.3	73.67	<200	200	
49292	DMETAL	TIN	ug/L	3	8	0.38	10.0	13.0	6.5	31.2	46.3	17.550	16.671	50.892	2	340	30.96	37.34	105.64	4.7	100	23.07	25.3	73.67	<200	200	

Table B-4
Comparison to Benchmark Data--Groundwater

Well No.	Test Group	Parameter	Unit	No. of Detects	No. of Samples	Freq. of Detect	Min. Nondetect	Max. Nondetect	Max. Nondetect	Min. Detect	Max. Detect	Arith. Mean	Stand. Dev.	m + 2s	Upper Geo Chem. Min	Upper Geo Chem Max	Upper Geo. Chem. Mean	Std. Dev.	Mean Plus 2 SD	Min Lower Geo	Max Lower Geo	Mean Lower Geo	Std. Dev.	Mean Plus 2 SD	Min (Dragun)	Max (Dragun)	Standard (1)
49192	TMETAL	TIN	ug/L	2	8	0.25	10.0	29.0	14.5	38.4	47.8	16.275	17.018	50.312	4.7	100	33.88	35.33	104.54	4.7	100	27.46	31.18	89.82	<200	200	
49292	TMETAL	TIN	ug/L		8		10.0	29.0	14.5					0.000	4.7	100	33.88	35.33	104.54	4.7	100	27.46	31.18	89.82	<200	200	
49192	DRADS	URANIUM-233/234	pCi/L	6	6	1.00				0.26	4.84	2.750	1.556	5.861	-0.02	199.5	6.23	23.94	54.11	-0.01	15.33	1.64	2.85	7.34			
49292	DRADS	URANIUM-233/234	pCi/L	6	6	1.00				0.3117	1.2	0.694	0.322	1.338	-0.02	199.5	6.23	23.94	54.11	-0.01	15.33	1.64	2.85	7.34			
49192	TRADS	URANIUM-233/234	pCi/L	2	2	1.00				3.4	4.6	4.000	0.849	5.697	0	164	15.62	38.75	93.12	0.15	1.52	0.77	0.57	1.91			
49292	TRADS	URANIUM-233/234	pCi/L	2	2	1.00				0.64	0.87	0.755	0.163	1.080	0	164	15.62	38.75	93.12	0.15	1.52	0.77	0.57	1.91			
49192	DRADS	URANIUM-235	pCi/L	6	6	1.00				0.028	0.29	0.135	0.117	0.368	-0.04	4.8	0.2	0.64	1.48	-0.04	0.23	0.03	0.06	0.15			
49292	DRADS	URANIUM-235	pCi/L	6	6	1.00				-0.025	0.18	0.063	0.075	0.213	-0.04	4.8	0.2	0.64	1.48	-0.04	0.23	0.03	0.06	0.15			
49192	TRADS	URANIUM-235	pCi/L	2	2	1.00				0.12	0.2	0.160	0.057	0.273	-0.02	6.29	0.62	1.38	3.38	0	0.04	0.03	0.02	0.07			
49292	TRADS	URANIUM-235	pCi/L	2	2	1.00				0	0.083	0.042	0.059	0.159	-0.02	6.29	0.62	1.38	3.38	0	0.04	0.03	0.02	0.07			
49192	DRADS	URANIUM-238	pCi/L	6	6	1.00				0.26	2.5	1.653	0.916	3.485	-0.04	135.6	4.77	17.71	40.19	-0.18	8.01	0.77	1.53	3.83			
49292	DRADS	URANIUM-238	pCi/L	6	6	1.00				0.1341	0.7	0.466	0.226	0.917	-0.04	135.6	4.77	17.71	40.19	-0.18	8.01	0.77	1.53	3.83			
49192	TRADS	URANIUM-238	pCi/L	2	2	1.00				2.1	4.2	3.150	1.485	6.120	0	108	10.84	27.73	66.3	0.17	0.53	0.35	0.26	0.87			
49292	TRADS	URANIUM-238	pCi/L	2	2	1.00				0.7	0.91	0.805	0.148	1.102	0	108	10.84	27.73	66.3	0.17	0.53	0.35	0.26	0.87			
49192	DMETAL	VANADIUM	ug/L		8		2.0	14.0	7					0.000	0.6	50	7.92	8.73	25.38	0.5	25	6.71	7.6	21.91	<1	10	
49292	DMETAL	VANADIUM	ug/L		8		2.0	14.0	7					0.000	0.6	50	7.92	8.73	25.38	0.5	25	6.71	7.6	21.91	<1	10	
49192	TMETAL	VANADIUM	ug/L	4	8	0.50	2.9	14.0	7	6.2	70.2	25.756	29.488	84.732	1	123	13.81	14.09	41.99	0.5	46.7	10.43	11.26	32.95	<1	10	
49292	TMETAL	VANADIUM	ug/L		8		2.0	14.0	7					0.000	1	123	13.81	14.09	41.99	0.5	46.7	10.43	11.26	32.95	<1	10	
49192	DMETAL	ZINC	ug/L	3	8	0.38	2.0	3.0	1.5	5.6	47.6	8.319	16.029	40.378	1	137	14.03	17.87	49.77	1	80.9	10.96	10.2	31.36	<10	2000	5000 (sec)
49292	DMETAL	ZINC	ug/L	3	8	0.38	3.0	10.7	5.35	3.1	16.5	4.800	4.974	14.748	1	137	14.03	17.87	49.77	1	80.9	10.96	10.2	31.36	<10	2000	5000 (sec)
49192	TMETAL	ZINC	ug/L	8	8	1.00				18.2	158	63.200	58.033	179.266	4.2	498	37.16	49.8	136.76	5	189	52.45	51.31	155.07	<10	2000	
49292	TMETAL	ZINC	ug/L	3	8	0.38	2.0	12.6	6.3	9.5	20.5	6.950	6.686	20.323	4.2	498	37.16	49.8	136.76	5	189	52.45	51.31	155.07	<10	2000	

(1) Colorado Basic Standards--(dw) drinking water, (sec) secondary, (ag) agricultural.
(a) Boyles et al.
(b) Lowry Landfill background data.
Notes:
CDPHE Screen Report/Draft 2/Table B4.
DMETAL = Dissolved metal (filtered).
TMETAL = Total metal (unfiltered).

Appendix C
EXAMPLE OF WEIGHT-OF-EVIDENCE EVALUATIONS

APPENDIX C. EXAMPLE OF WEIGHT-OF-EVIDENCE EVALUATIONS

Appendix C contains an example of the weight-of-evidence evaluations used for Step 1 of the CDPHE Conservative Screen. This example is Section 3.9 of TM 4 (DOE, 1994b) and describes the weight-of-evidence evaluation process and results for arsenic in OU 3 surface sediments.

et al., 1984). Sediment data were also available from Cherry Creek Reservoir (DRCOG, 1994). In addition, background sediment stream data from the Lowry Landfill Superfund site was also used (EPA, 1992).

The primary data sets identified during the benchmark data collection activities for surface water included Ralston Creek, Croke Canal, and Farmer's Highline Canal (Arvada, 1994DB). The reservoir data were compared to Chatfield Reservoir, Cherry Creek Reservoir, Bear Creek Lake, and Harriman Lake (Arvada, 1994DB; EPA, 1993DB and 1994DB).

During the benchmark data-collection activities, information was also collected from lakes outside of Colorado for comparative purposes. Data from Superfund sites and other impacted areas were also collected. The purpose of using information from contaminated sites is to place the OU 3 concentration/activity levels in perspective with other investigated sites. These data sets are presented in figures summarizing the OU 3 concentrations/activities for a given chemical in Sections 5.0 and 6.0.

3.9 WEIGHT-OF-EVIDENCE EXAMPLE

This subsection presents an illustration of how the weight-of-evidence evaluation was applied to arsenic measured in OU 3 surface sediments.

A summary of the analytical results for arsenic in sediments (for each IHSS) is presented in Appendix C (Tables C-3 to C-9). Appendix C shows the summary statistics (before the COC selection was performed) by IHSS, including number of detects, number of samples, frequency of detection, minimum nondetected value, maximum nondetected value, minimum detected value, maximum detected value, arithmetic mean, standard deviation, normal 95 percent upper confidence limit (UCL), and lognormal 95 UCL. The summary statistics are used to provide the analyst the makeup of the data set (i.e., the frequency of detection and magnitude of concentration) before the COC selection process is performed. The use of summary statistics is part of an exploratory analysis phase that involved using visual and graphical presentations of the data (every chemical will not be displayed visually in this TM).

3.9.1 Comparison of OU 3 Data to Benchmark Data

This step involves comparing the OU 3 data to benchmark data in a less formal, quantitative manner than using the five statistical tests described in Subsection 3.1. However, this step alone cannot eliminate arsenic as a COC. The benchmark data comparison in conjunction with the other weight-of-evidence evaluations provides the rationale that arsenic is not a COC.

This evaluation step for arsenic involved the use of a visual data-presentation technique (Figure 3-6) where the magnitude of concentrations of the OU 3 data for streams and reservoir sediment are presented with the Rocky Flats background data for stream sediments and relevant benchmark data from the literature. The top portion of Figure 3-6 is a tabulation of these data; the bottom segment profiles the data to promote comparison of individual data points as well as ranges. The data presented in Figure 3-6 include sediment data from Superfund sites, Rocky Mountain National Park lakes, the Great Lakes, Adirondack lakes, Cherry Creek Reservoir in Colorado, Missoula Lake bed sediments, and worldwide data. The purpose of using information from contaminated sites (the Warm Springs Pond Superfund site and the Clear Creek Superfund site) in addition to nonimpacted sites is to place OU 3 levels in perspective with other investigated sites.

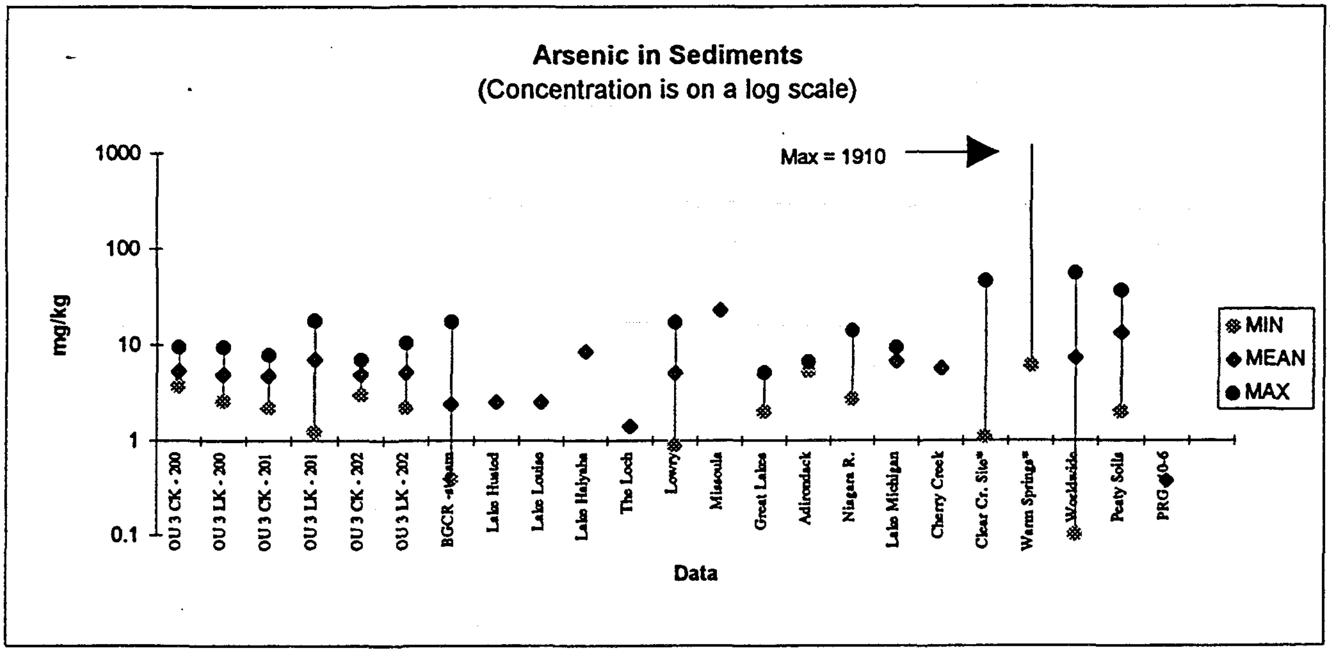
Figure 3-6 illustrates the following:

- The arsenic concentrations for OU 3 sediments between the IHSSs are consistent. All reported concentrations are less than 17.7 milligrams per kilogram (mg/kg) and there are no apparent spurious data that would suggest anomalous concentrations.

- The range of OU 3 arsenic concentrations in reservoirs (1.2 to 17.7 mg/kg) is comparable with the ranges of the BGCR (DOE, 1993c) data (sediments that are not impacted) – 0.39 to 17.3 mg/kg. Additionally, the OU 3 and background data are within the range, and comparable to, the expected worldwide ranges (0.1 to 55 mg/kg, mean of 7.2 mg/kg).

ARSENIC IN SEDIMENTS
(mg/kg)

DATA	MIN	MEAN	MAX	STD DEV	COMMENTS/SOURCE
OU 3 CK - 200	3.7	5.31	9.4	1.85	Great Western Reservoir (Creek) (OU 3 Database)
OU 3 LK - 200	2.6	4.91	9.4	1.46	Great Western Reservoir (Lake) (OU 3 Database)
OU 3 CK - 201	2.2	4.76	7.8	1.53	Standley Lake (Creek) (OU 3 Database)
OU 3 LK - 201	1.2	6.96	17.7	4.34	Standley Lake (Lake) (OU 3 Database)
OU 3 CK - 202	3	4.88	6.8	1.56	Mower Reservoir (Creek) (OU 3 Database)
OU 3 LK - 202	2.2	5.15	10.4	1.96	Mower Reservoir (Lake) (OU 3 Database)
BGCR -stream	0.39	2.4	17.3	2.45	RFP Background Stream Sediments, BGCR (DOE, 1993c)
Lake Husted		2.5		0.2	Rocky Mountain National Park Lake Surface Sediment (Heit et al., 1984)
Lake Louise		2.5		0.3	Rocky Mountain National Park Lake Surface Sediment (Heit et al., 1984)
Lake Haiyaha		8.4		0.2	Rocky Mountain National Park Lake Surface Sediment (Heit et al., 1984)
The Loch		1.4		0.2	Rocky Mountain National Park Lake Surface Sediment (Heit et al., 1984)
Lowry	0.9	5	17	4	Lowry Landfill Background Stream Sediment OUs 2-5 Baseline Risk Assessment (EPA, 1992)
Missoula		23			Missoula Lake Beds Surface Sediment (Moore and Ramamoorthy, 1984)
Great Lakes	2		5		Great Lakes Surface Sediment (Fergusson, 1990)
Adirondack	5.3		6.5		Lake Adirondack Surface Sediment (Fergusson, 1990)
Niagara R.	2.7		14		Niagara River Sediment (polluted) (Fergusson, 1990)
Lake Michigan		6.6	9.2		Lake Michigan Surface Sediment (Fergusson, 1990)
Cherry Creek		5.57			Cherry Creek Reservoir Surface Sediment (CCBA, 1994)
Clear Cr. Site*	1.1		46		Clear Creek Superfund Site (CDPHE, 1990)
Warm Springs	6		1910		Warm Springs Pond Superfund Site, Pond Bottom Sediments (EPA, 1988)
Worldwide	0.1	7.2	55	7.2	Worldwide Sediment (Boyle & Jonasson, 1973)
Peaty Soils	2	13.4	36	9.4	Peaty Soils (Boyle & Jonasson, 1973)
PRG--10^{-6}		0.37			10^{-6} PRG level based on a residential soil scenario (EG&G, 1994a)



Notes: If blank, no data are available.
*Indicates Superfund site.
OU 3 CK-200 = Creek sediment data in IHSS 200.
OU 3 LK-200 = Lake sediment data in IHSS 200.

Figure 3-6
EXAMPLE DATA COMPARISON–ARSENIC IN SEDIMENTS

- The profile of the OU 3 mean concentrations of arsenic in OU 3 sediments (4.76 to 6.96 mg/kg) shows concentrations comparable to ranges of Lowry Landfill Superfund site stream sediments that are assumed not to be impacted (0.9 to 17 mg/kg).

- Both the OU 3 data and the benchmark data are distinguishable from these data representing arsenic contamination (e.g., Warm Springs Pond, Clear Creek). Arsenic concentrations in OU 3 are not within the upper end of the ranges of heavily polluted sites (Warm Springs Pond and Clear Creek). The maximum arsenic concentration in OU 3 sediments ranges from 6.8 mg/kg to 17.7 mg/kg, compared with 46 mg/kg at the Clear Creek Superfund site (CDPHE, 1990) and 1,910 mg/kg at the Warm Springs Pond Superfund site (EPA, 1988).

3.9.2 Temporal Analysis

OU 3 analytical data were also evaluated over time (if sufficient data collected over time were available) to discern any anomalous trend or pattern. Concentration levels sharply elevated at one point in time may indicate a historical release event contributing to concentrations above background. Sediment core profiles were analyzed for some analytes to evaluate if possible patterns existed throughout the sediment layer. Analyte profiles with discernible peaks may indicate source discharges from the RFETS.

Arsenic concentrations in sediment core profiles did not show any consistent peaks or patterns (Figure 3-7). The concentrations of arsenic in the sediment core samples range from 3.6 mg/kg to 35 mg/kg.

3.9.3 Spatial Analysis

Spatial analyses were performed for analytes in OU 3 sediments by evaluating patterns of concentrations at discreet sample points in each IHSS. Analytes showing a distinct spatial orientation rather than being randomly distributed may be designated as potential sources or potential hot spots. The physical processes (e.g., sedimentation near the inflow of a stream into a lake) affecting concentration distribution and the contribution of various water sources to OU 3 reservoirs are also assessed.

Arsenic concentrations were plotted at every sediment sample location in each IHSS on a map generated by GIS (see Figures F-1, F-2, and F-3 in Appendix F of this TM). The maps show that the arsenic concentrations tend to be higher in the samples collected in the middle of the reservoir than along the exposed shoreline and stream sediment samples. However, along the shoreline, in the streams, and in the middle areas of the reservoirs the arsenic levels are apparently randomly distributed. There is no discernible pattern of arsenic concentration in sediments, thus suggesting a natural, randomly distributed population. The distribution of data points is further evaluated in Subsection 3.8.4.

Natural limnological phenomena explain the slightly elevated concentrations in the center of the reservoirs. The finer particles of sediment tend to have the highest concentrations of organic matter and thus higher arsenic concentrations (Davis and Kent, 1990). The metals in OU 3 tend to exhibit this natural concentration distribution. The shoreline sediments are exposed most of the year and the finer-grained particles are preferentially removed by wind and water erosion. These finer-sediment particles in the water column also tend to deposit in the center of the lake where flow velocities can no longer support particle suspension.

3.9.4 Probability Plot Analysis

A software package, PROBPLOT, was used to assess populations within the OU 3 data sets (see Appendix G). PROBPLOT is conventionally used in the minerals exploration industry to guide investigators seeking anomalous mineral deposits (i.e., significantly above background) for extraction (Sinclair, 1986; Sinclair, 1976; Stanley, 1987). In this study, concentration data (detects only) for those chemicals with sufficient data (15 samples above detection limits for a given analyte and IHSS) were lognormally transformed and plotted on a cumulative frequency graph. Based on the cumulative frequency distribution, the number of populations for a given data set were identified. If one population was identified, it was inferred to represent a background population based on the comparison to background and benchmark data and the physicochemical processes occurring in the reservoirs. If two populations existed, it is possible that the higher population is the result of contamination. With two populations having low concentrations and concentrations that do not vary significantly between each other, however, the two populations may be explained by natural physical processes and not necessarily contamination (see Appendix G for examples).

According to the geochemical analysis using PROBPLOT, only one population is seen for arsenic in each of the three reservoirs. Figure 3-8 shows an example of PROBPLOT output for arsenic in Great Western Reservoir (IHSS 200). Because of low concentrations (comparable to benchmark data) and the lack of separate populations, arsenic in OU 3 samples is identified as falling within the background population. Although Standley Lake (IHSS 201) has a maximum that is almost twice that of Great Western Reservoir (IHSS 200) and Mower Reservoir (IHSS 202), the means are essentially equal and fall within benchmark data. Since Mower Reservoir receives 100 percent of its water input from the Rocky Flats Plant drainage area, and Great Western Reservoir and Standley Lake receive 65 percent to more than 90 percent, respectively, of water input from Clear Creek (ASI, 1990) one might expect significantly higher concentrations in Mower Reservoir if RFETS-related contamination were present. However, the arsenic concentrations in Mower Reservoir sediment are not significantly greater than Great Western Reservoir or Standley Lake; this suggests that arsenic originates from background sources and was deposited in the IHSS reservoirs by natural processes.

3.9.5 Conclusions from the Weight-of-Evidence Evaluation

Based on the full weight of the evidence presented in this section, the similarity of the OU 3 mean concentrations to background and benchmark, the probability plot analysis, and the lack of discernible spatial trends, arsenic has been eliminated as a COC in surface sediment for the three IHSSs.

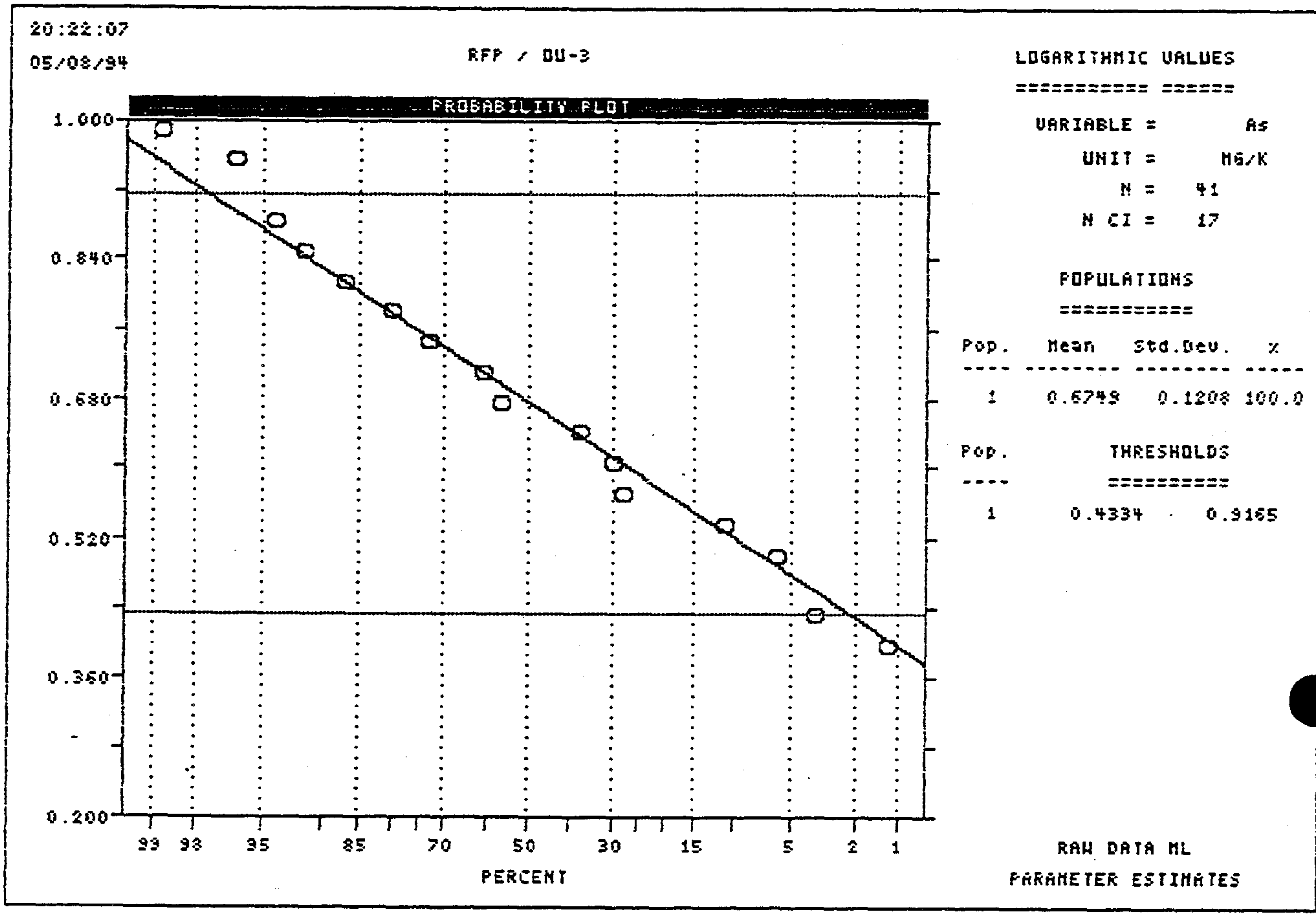


Figure 3-8
EXAMPLE PROBPLOT - ARSENIC IN
IHSS 200 SEDIMENTS

Appendix D
RBC RATIOS FOR IHSSs 199 AND 200

APPENDIX D. RBC RATIOS FOR IHSS 199 AND 200

Appendix D contains the following tables:

Table D-1. Ratios of PCOC Concentrations/Activities to RBCs, OU 3 Surface Soil. (maximum detected result for each sample location, RBCs, PCOC-specific RBC ratios, and toxicity values used for RBCs).

Table D-2. Ratios of PCOC Concentrations/Activities to RBCs, OU 3 IHSS 200 Sediments and Groundwater. (maximum detected result for each PCOC per medium, RBCs, PCOC-specific RBC ratios, and toxicity values used for RBCs).

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
PT12592	AMERICIUM-241	PCI/G	.0120	2.3728	.0051	2.400e-010	3.200e-008	4.900e-009
PT12592	PLUTONIUM-239/240	PCI/G	.0285	3.4255	.0083	2.300e-010	3.800e-008	1.700e-011
PT12692	AMERICIUM-241	PCI/G	.0120	2.3728	.0051	2.400e-010	3.200e-008	4.900e-009
PT12692	PLUTONIUM-239/240	PCI/G	.0230	3.4255	.0067	2.300e-010	3.800e-008	1.700e-011
PT12792	AMERICIUM-241	PCI/G	.0292	2.3728	.0123	2.400e-010	3.200e-008	4.900e-009
PT12792	PLUTONIUM-239/240	PCI/G	.1324	3.4255	.0387	2.300e-010	3.800e-008	1.700e-011
PT12892	AMERICIUM-241	PCI/G	.0302	2.3728	.0127	2.400e-010	3.200e-008	4.900e-009
PT12892	PLUTONIUM-239/240	PCI/G	.0364	3.4255	.0106	2.300e-010	3.800e-008	1.700e-011
PT12992	PLUTONIUM-239/240	PCI/G	.0205	3.4255	.0060	2.300e-010	3.800e-008	1.700e-011
PT13092	AMERICIUM-241	PCI/G	.0210	2.3728	.0089	2.400e-010	3.200e-008	4.900e-009
PT13092	PLUTONIUM-239/240	PCI/G	.0465	3.4255	.0136	2.300e-010	3.800e-008	1.700e-011
PT13192	AMERICIUM-241	PCI/G	.0275	2.3728	.0116	2.400e-010	3.200e-008	4.900e-009
PT13192	PLUTONIUM-239/240	PCI/G	.0685	3.4255	.0200	2.300e-010	3.800e-008	1.700e-011
PT13292	AMERICIUM-241	PCI/G	.0080	2.3728	.0034	2.400e-010	3.200e-008	4.900e-009
PT13292	PLUTONIUM-239/240	PCI/G	.0170	3.4255	.0050	2.300e-010	3.800e-008	1.700e-011
PT13392	AMERICIUM-241	PCI/G	.0110	2.3728	.0046	2.400e-010	3.200e-008	4.900e-009
PT13392	PLUTONIUM-239/240	PCI/G	.0406	3.4255	.0119	2.300e-010	3.800e-008	1.700e-011
PT13492	AMERICIUM-241	PCI/G	.0030	2.3728	.0013	2.400e-010	3.200e-008	4.900e-009
PT13492	PLUTONIUM-239/240	PCI/G	.0300	3.4255	.0088	2.300e-010	3.800e-008	1.700e-011
PT13592	AMERICIUM-241	PCI/G	.0615	2.3728	.0259	2.400e-010	3.200e-008	4.900e-009
PT13592	PLUTONIUM-239/240	PCI/G	.2050	3.4255	.0598	2.300e-010	3.800e-008	1.700e-011
PT13792	AMERICIUM-241	PCI/G	.0107	2.3728	.0045	2.400e-010	3.200e-008	4.900e-009
PT13792	PLUTONIUM-239/240	PCI/G	.0343	3.4255	.0100	2.300e-010	3.800e-008	1.700e-011
PT14092	AMERICIUM-241	PCI/G	.0095	2.3728	.0040	2.400e-010	3.200e-008	4.900e-009
PT14092	PLUTONIUM-239/240	PCI/G	.0205	3.4255	.0060	2.300e-010	3.800e-008	1.700e-011
PT14192	AMERICIUM-241	PCI/G	.5200	2.3728	.2192	2.400e-010	3.200e-008	4.900e-009
PT14192	PLUTONIUM-239/240	PCI/G	2.9500	3.4255	.8612	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Based Concentration
SF = slope factor

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
PT14292	AMERICIUM-241	PCI/G	.0130	2.3728	.0055	2.400e-010	3.200e-008	4.900e-009
PT14292	PLUTONIUM-239/240	PCI/G	.2800	3.4255	.0817	2.300e-010	3.800e-008	1.700e-011
PT14392	AMERICIUM-241	PCI/G	.0200	2.3728	.0084	2.400e-010	3.200e-008	4.900e-009
PT14392	PLUTONIUM-239/240	PCI/G	.2700	3.4255	.0788	2.300e-010	3.800e-008	1.700e-011
PT14492	AMERICIUM-241	PCI/G	.0330	2.3728	.0139	2.400e-010	3.200e-008	4.900e-009
PT14492	PLUTONIUM-239/240	PCI/G	.0151	3.4255	.0044	2.300e-010	3.800e-008	1.700e-011
PT14592	AMERICIUM-241	PCI/G	.0295	2.3728	.0124	2.400e-010	3.200e-008	4.900e-009
PT14592	PLUTONIUM-239/240	PCI/G	.0680	3.4255	.0199	2.300e-010	3.800e-008	1.700e-011
PT14692	AMERICIUM-241	PCI/G	.0130	2.3728	.0055	2.400e-010	3.200e-008	4.900e-009
PT14692	PLUTONIUM-239/240	PCI/G	.0345	3.4255	.0101	2.300e-010	3.800e-008	1.700e-011
PT14792	AMERICIUM-241	PCI/G	.0062	2.3728	.0026	2.400e-010	3.200e-008	4.900e-009
PT14792	PLUTONIUM-239/240	PCI/G	.0128	3.4255	.0037	2.300e-010	3.800e-008	1.700e-011
PT14892	AMERICIUM-241	PCI/G	.0010	2.3728	.0004	2.400e-010	3.200e-008	4.900e-009
PT14892	PLUTONIUM-239/240	PCI/G	.0075	3.4255	.0022	2.300e-010	3.800e-008	1.700e-011
PT14992	AMERICIUM-241	PCI/G	.0227	2.3728	.0096	2.400e-010	3.200e-008	4.900e-009
PT14992	PLUTONIUM-239/240	PCI/G	.0946	3.4255	.0276	2.300e-010	3.800e-008	1.700e-011
PT15092	AMERICIUM-241	PCI/G	.0355	2.3728	.0150	2.400e-010	3.200e-008	4.900e-009
PT15092	PLUTONIUM-239/240	PCI/G	.1604	3.4255	.0468	2.300e-010	3.800e-008	1.700e-011
PT15192	AMERICIUM-241	PCI/G	.0805	2.3728	.0339	2.400e-010	3.200e-008	4.900e-009
PT15192	PLUTONIUM-239/240	PCI/G	.7450	3.4255	.2175	2.300e-010	3.800e-008	1.700e-011
PT15292	AMERICIUM-241	PCI/G	.0953	2.3728	.0402	2.400e-010	3.200e-008	4.900e-009
PT15292	PLUTONIUM-239/240	PCI/G	.5107	3.4255	.1491	2.300e-010	3.800e-008	1.700e-011
PT15392	AMERICIUM-241	PCI/G	.0340	2.3728	.0143	2.400e-010	3.200e-008	4.900e-009
PT15392	PLUTONIUM-239/240	PCI/G	.2150	3.4255	.0628	2.300e-010	3.800e-008	1.700e-011
PT15492	AMERICIUM-241	PCI/G	.0255	2.3728	.0107	2.400e-010	3.200e-008	4.900e-009
PT15492	PLUTONIUM-239/240	PCI/G	.0545	3.4255	.0159	2.300e-010	3.800e-008	1.700e-011
PT15592	AMERICIUM-241	PCI/G	.0135	2.3728	.0057	2.400e-010	3.200e-008	4.900e-009
PT15592	PLUTONIUM-239/240	PCI/G	.0413	3.4255	.0121	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Ba[illegible]d Concentration
SF = slope [illegible]r

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
PT15692	AMERICIUM-241	PCI/G	.0185	2.3728	.0078	2.400e-010	3.200e-008	4.900e-009
PT15692	PLUTONIUM-239/240	PCI/G	.0360	3.4255	.0105	2.300e-010	3.800e-008	1.700e-011
PT15792	AMERICIUM-241	PCI/G	-.0020	2.3728	-.0008	2.400e-010	3.200e-008	4.900e-009
PT15792	PLUTONIUM-239/240	PCI/G	.0115	3.4255	.0034	2.300e-010	3.800e-008	1.700e-011
PT15892	AMERICIUM-241	PCI/G	.0040	2.3728	.0017	2.400e-010	3.200e-008	4.900e-009
PT15892	PLUTONIUM-239/240	PCI/G	.0415	3.4255	.0121	2.300e-010	3.800e-008	1.700e-011
PT15992	AMERICIUM-241	PCI/G	.0060	2.3728	.0025	2.400e-010	3.200e-008	4.900e-009
PT15992	PLUTONIUM-239/240	PCI/G	.2820	3.4255	.0823	2.300e-010	3.800e-008	1.700e-011
PT16092	AMERICIUM-241	PCI/G	.0035	2.3728	.0015	2.400e-010	3.200e-008	4.900e-009
PT16092	PLUTONIUM-239/240	PCI/G	.0410	3.4255	.0120	2.300e-010	3.800e-008	1.700e-011
PT16192	AMERICIUM-241	PCI/G	.0158	2.3728	.0066	2.400e-010	3.200e-008	4.900e-009
PT16192	PLUTONIUM-239/240	PCI/G	.0523	3.4255	.0153	2.300e-010	3.800e-008	1.700e-011
PT16292	AMERICIUM-241	PCI/G	.0675	2.3728	.0284	2.400e-010	3.200e-008	4.900e-009
PT16292	PLUTONIUM-239/240	PCI/G	.0890	3.4255	.0260	2.300e-010	3.800e-008	1.700e-011
PT16392	AMERICIUM-241	PCI/G	.0535	2.3728	.0225	2.400e-010	3.200e-008	4.900e-009
PT16392	PLUTONIUM-239/240	PCI/G	.1145	3.4255	.0334	2.300e-010	3.800e-008	1.700e-011
PT16492	AMERICIUM-241	PCI/G	.0079	2.3728	.0033	2.400e-010	3.200e-008	4.900e-009
PT16492	PLUTONIUM-239/240	PCI/G	.0238	3.4255	.0069	2.300e-010	3.800e-008	1.700e-011
PT16592	AMERICIUM-241	PCI/G	.0131	2.3728	.0055	2.400e-010	3.200e-008	4.900e-009
PT16592	PLUTONIUM-239/240	PCI/G	.0340	3.4255	.0099	2.300e-010	3.800e-008	1.700e-011
PT16692	AMERICIUM-241	PCI/G	.0267	2.3728	.0112	2.400e-010	3.200e-008	4.900e-009
PT16692	PLUTONIUM-239/240	PCI/G	.0402	3.4255	.0117	2.300e-010	3.800e-008	1.700e-011
PT16792	AMERICIUM-241	PCI/G	.0005	2.3728	.0002	2.400e-010	3.200e-008	4.900e-009
PT16792	PLUTONIUM-239/240	PCI/G	.0200	3.4255	.0058	2.300e-010	3.800e-008	1.700e-011
PT16992	AMERICIUM-241	PCI/G	.0025	2.3728	.0011	2.400e-010	3.200e-008	4.900e-009
PT16992	PLUTONIUM-239/240	PCI/G	.0280	3.4255	.0082	2.300e-010	3.800e-008	1.700e-011
PT17092	AMERICIUM-241	PCI/G	.0110	2.3728	.0046	2.400e-010	3.200e-008	4.900e-009
PT17092	PLUTONIUM-239/240	PCI/G	.0305	3.4255	.0089	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Based Concentration
SF = slope factor

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
PT17192	AMERICIUM-241	PCI/G	.0265	2.3728	.0111	2.400e-010	3.200e-008	4.900e-009
PT17192	PLUTONIUM-239/240	PCI/G	.0165	3.4255	.0048	2.300e-010	3.800e-008	1.700e-011
PT17292	PLUTONIUM-239/240	PCI/G	.0852	3.4255	.0249	2.300e-010	3.800e-008	1.700e-011
PT17392	AMERICIUM-241	PCI/G	.0045	2.3728	.0019	2.400e-010	3.200e-008	4.900e-009
PT17392	PLUTONIUM-239/240	PCI/G	.0340	3.4255	.0099	2.300e-010	3.800e-008	1.700e-011
PT17492	AMERICIUM-241	PCI/G	.0020	2.3728	.0008	2.400e-010	3.200e-008	4.900e-009
PT17492	PLUTONIUM-239/240	PCI/G	.0165	3.4255	.0048	2.300e-010	3.800e-008	1.700e-011
PT17692	AMERICIUM-241	PCI/G	.0035	2.3728	.0015	2.400e-010	3.200e-008	4.900e-009
PT17692	PLUTONIUM-239/240	PCI/G	.0120	3.4255	.0035	2.300e-010	3.800e-008	1.700e-011
PT17792	AMERICIUM-241	PCI/G	.0080	2.3728	.0034	2.400e-010	3.200e-008	4.900e-009
PT17792	PLUTONIUM-239/240	PCI/G	.0740	3.4255	.0216	2.300e-010	3.800e-008	1.700e-011
PT17992	AMERICIUM-241	PCI/G	.0139	2.3728	.0059	2.400e-010	3.200e-008	4.900e-009
PT17992	PLUTONIUM-239/240	PCI/G	.0586	3.4255	.0171	2.300e-010	3.800e-008	1.700e-011
PT18592	AMERICIUM-241	PCI/G	.0985	2.3728	.0415	2.400e-010	3.200e-008	4.900e-009
PT18592	PLUTONIUM-239/240	PCI/G	.6650	3.4255	.1941	2.300e-010	3.800e-008	1.700e-011
PT18692	AMERICIUM-241	PCI/G	.0355	2.3728	.0150	2.400e-010	3.200e-008	4.900e-009
PT18692	PLUTONIUM-239/240	PCI/G	.7350	3.4255	.2146	2.300e-010	3.800e-008	1.700e-011
PT18792	AMERICIUM-241	PCI/G	.0113	2.3728	.0048	2.400e-010	3.200e-008	4.900e-009
PT18792	PLUTONIUM-239/240	PCI/G	.0510	3.4255	.0149	2.300e-010	3.800e-008	1.700e-011
PT18892	AMERICIUM-241	PCI/G	.0125	2.3728	.0053	2.400e-010	3.200e-008	4.900e-009
PT18892	PLUTONIUM-239/240	PCI/G	.0208	3.4255	.0061	2.300e-010	3.800e-008	1.700e-011
PT18992	PLUTONIUM-239/240	PCI/G	.0194	3.4255	.0057	2.300e-010	3.800e-008	1.700e-011
PT19092	AMERICIUM-241	PCI/G	.0088	2.3728	.0037	2.400e-010	3.200e-008	4.900e-009
PT19092	PLUTONIUM-239/240	PCI/G	.0322	3.4255	.0094	2.300e-010	3.800e-008	1.700e-011
PT19192	AMERICIUM-241	PCI/G	.0377	2.3728	.0159	2.400e-010	3.200e-008	4.900e-009
PT19192	PLUTONIUM-239/240	PCI/G	.1480	3.4255	.0432	2.300e-010	3.800e-008	1.700e-011
PT19292	AMERICIUM-241	PCI/G	.1659	2.3728	.0699	2.400e-010	3.200e-008	4.900e-009
PT19292	PLUTONIUM-239/240	PCI/G	.3210	3.4255	.0937	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk B[illegible] Concentration
SF = slope [illegible]r

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
PT19392	PLUTONIUM-239/240	PCI/G	.0140	3.4255	.0041	2.300e-010	3.800e-008	1.700e-011
PT19492	AMERICIUM-241	PCI/G	.0765	2.3728	.0322	2.400e-010	3.200e-008	4.900e-009
PT19492	PLUTONIUM-239/240	PCI/G	.0865	3.4255	.0253	2.300e-010	3.800e-008	1.700e-011
PT19592	AMERICIUM-241	PCI/G	.0515	2.3728	.0217	2.400e-010	3.200e-008	4.900e-009
PT19592	PLUTONIUM-239/240	PCI/G	.2500	3.4255	.0730	2.300e-010	3.800e-008	1.700e-011
PT19692	AMERICIUM-241	PCI/G	.0060	2.3728	.0025	2.400e-010	3.200e-008	4.900e-009
PT19692	PLUTONIUM-239/240	PCI/G	.0090	3.4255	.0026	2.300e-010	3.800e-008	1.700e-011
T10	AMERICIUM-241	PCI/G	.0532	2.3728	.0224	2.400e-010	3.200e-008	4.900e-009
T10	PLUTONIUM-239/240	PCI/G	.2487	3.4255	.0726	2.300e-010	3.800e-008	1.700e-011
T11	AMERICIUM-241	PCI/G	.0647	2.3728	.0273	2.400e-010	3.200e-008	4.900e-009
T11	PLUTONIUM-239/240	PCI/G	.4803	3.4255	.1402	2.300e-010	3.800e-008	1.700e-011
T12A	AMERICIUM-241	PCI/G	.0487	2.3728	.0205	2.400e-010	3.200e-008	4.900e-009
T12A	PLUTONIUM-239/240	PCI/G	.2883	3.4255	.0842	2.300e-010	3.800e-008	1.700e-011
T12B	AMERICIUM-241	PCI/G	.0483	2.3728	.0203	2.400e-010	3.200e-008	4.900e-009
T12B	PLUTONIUM-239/240	PCI/G	.3564	3.4255	.1040	2.300e-010	3.800e-008	1.700e-011
T13A	AMERICIUM-241	PCI/G	.1997	2.3728	.0842	2.400e-010	3.200e-008	4.900e-009
T13A	PLUTONIUM-239/240	PCI/G	.8913	3.4255	.2602	2.300e-010	3.800e-008	1.700e-011
T13B	AMERICIUM-241	PCI/G	.0951	2.3728	.0401	2.400e-010	3.200e-008	4.900e-009
T13B	PLUTONIUM-239/240	PCI/G	.6856	3.4255	.2001	2.300e-010	3.800e-008	1.700e-011
T14A	AMERICIUM-241	PCI/G	.1000	2.3728	.0421	2.400e-010	3.200e-008	4.900e-009
T14A	PLUTONIUM-239/240	PCI/G	.6077	3.4255	.1774	2.300e-010	3.800e-008	1.700e-011
T14B	AMERICIUM-241	PCI/G	.0882	2.3728	.0372	2.400e-010	3.200e-008	4.900e-009
T14B	PLUTONIUM-239/240	PCI/G	.4324	3.4255	.1262	2.300e-010	3.800e-008	1.700e-011
T15A	AMERICIUM-241	PCI/G	.2128	2.3728	.0897	2.400e-010	3.200e-008	4.900e-009
T15A	PLUTONIUM-239/240	PCI/G	1.3360	3.4255	.3900	2.300e-010	3.800e-008	1.700e-011
T15B	AMERICIUM-241	PCI/G	.1403	2.3728	.0591	2.400e-010	3.200e-008	4.900e-009
T15B	PLUTONIUM-239/240	PCI/G	1.0840	3.4255	.3165	2.300e-010	3.800e-008	1.700e-011
T1A	PLUTONIUM-239/240	PCI/G	.9517	3.4255	.2778	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Based Concentration
SF = slope factor

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
T1B	PLUTONIUM-239/240	PCI/G	1.4750	3.4255	.4306	2.300e-010	3.800e-008	1.700e-011
T2A	PLUTONIUM-239/240	PCI/G	.7572	3.4255	.2211	2.300e-010	3.800e-008	1.700e-011
T2B	PLUTONIUM-239/240	PCI/G	.6805	3.4255	.1987	2.300e-010	3.800e-008	1.700e-011
T2C	PLUTONIUM-239/240	PCI/G	1.6000	3.4255	.4671	2.300e-010	3.800e-008	1.700e-011
T3A	PLUTONIUM-239/240	PCI/G	.9228	3.4255	.2694	2.300e-010	3.800e-008	1.700e-011
T3B	PLUTONIUM-239/240	PCI/G	.7336	3.4255	.2142	2.300e-010	3.800e-008	1.700e-011
T3C	PLUTONIUM-239/240	PCI/G	.6555	3.4255	.1914	2.300e-010	3.800e-008	1.700e-011
T4A	AMERICIUM-241	PCI/G	.1614	2.3728	.0680	2.400e-010	3.200e-008	4.900e-009
T4A	PLUTONIUM-239/240	PCI/G	.8084	3.4255	.2360	2.300e-010	3.800e-008	1.700e-011
T4B	AMERICIUM-241	PCI/G	.0784	2.3728	.0330	2.400e-010	3.200e-008	4.900e-009
T4B	PLUTONIUM-239/240	PCI/G	.3650	3.4255	.1066	2.300e-010	3.800e-008	1.700e-011
T5	AMERICIUM-241	PCI/G	.1277	2.3728	.0538	2.400e-010	3.200e-008	4.900e-009
T5	PLUTONIUM-239/240	PCI/G	.5661	3.4255	.1653	2.300e-010	3.800e-008	1.700e-011
T6	AMERICIUM-241	PCI/G	.0603	2.3728	.0254	2.400e-010	3.200e-008	4.900e-009
T6	PLUTONIUM-239/240	PCI/G	.4764	3.4255	.1391	2.300e-010	3.800e-008	1.700e-011
T7	AMERICIUM-241	PCI/G	.0564	2.3728	.0238	2.400e-010	3.200e-008	4.900e-009
T7	PLUTONIUM-239/240	PCI/G	.1624	3.4255	.0474	2.300e-010	3.800e-008	1.700e-011
T8	AMERICIUM-241	PCI/G	.0406	2.3728	.0171	2.400e-010	3.200e-008	4.900e-009
T8	PLUTONIUM-239/240	PCI/G	.2252	3.4255	.0657	2.300e-010	3.800e-008	1.700e-011
T9	AMERICIUM-241	PCI/G	.1137	2.3728	.0479	2.400e-010	3.200e-008	4.900e-009
T9	PLUTONIUM-239/240	PCI/G	.5915	3.4255	.1727	2.300e-010	3.800e-008	1.700e-011
U10A	AMERICIUM-241	PCI/G	.3631	2.3728	.1530	2.400e-010	3.200e-008	4.900e-009
U10A	PLUTONIUM-239/240	PCI/G	1.7390	3.4255	.5077	2.300e-010	3.800e-008	1.700e-011
U10B	AMERICIUM-241	PCI/G	.2291	2.3728	.0966	2.400e-010	3.200e-008	4.900e-009
U10B	PLUTONIUM-239/240	PCI/G	1.0890	3.4255	.3179	2.300e-010	3.800e-008	1.700e-011
U11A	AMERICIUM-241	PCI/G	.1119	2.3728	.0472	2.400e-010	3.200e-008	4.900e-009
U11A	PLUTONIUM-239/240	PCI/G	.7180	3.4255	.2096	2.300e-010	3.800e-008	1.700e-011
U11B	AMERICIUM-241	PCI/G	.1406	2.3728	.0593	2.400e-010	3.200e-008	4.900e-009

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk B[illegible] Concentration
SF = slope [illegible]r

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
U11B	PLUTONIUM-239/240	PCI/G	.7711	3.4255	.2251	2.300e-010	3.800e-008	1.700e-011
U12A	AMERICIUM-241	PCI/G	.1948	2.3728	.0821	2.400e-010	3.200e-008	4.900e-009
U12A	PLUTONIUM-239/240	PCI/G	.9722	3.4255	.2838	2.300e-010	3.800e-008	1.700e-011
U12B	AMERICIUM-241	PCI/G	.1222	2.3728	.0515	2.400e-010	3.200e-008	4.900e-009
U12B	PLUTONIUM-239/240	PCI/G	.7422	3.4255	.2167	2.300e-010	3.800e-008	1.700e-011
U13A	AMERICIUM-241	PCI/G	.1965	2.3728	.0828	2.400e-010	3.200e-008	4.900e-009
U13A	PLUTONIUM-239/240	PCI/G	1.2720	3.4255	.3713	2.300e-010	3.800e-008	1.700e-011
U13B	AMERICIUM-241	PCI/G	.1585	2.3728	.0668	2.400e-010	3.200e-008	4.900e-009
U13B	PLUTONIUM-239/240	PCI/G	.7617	3.4255	.2224	2.300e-010	3.800e-008	1.700e-011
U14A	AMERICIUM-241	PCI/G	.1379	2.3728	.0581	2.400e-010	3.200e-008	4.900e-009
U14A	PLUTONIUM-239/240	PCI/G	.6831	3.4255	.1994	2.300e-010	3.800e-008	1.700e-011
U14B	AMERICIUM-241	PCI/G	.1613	2.3728	.0680	2.400e-010	3.200e-008	4.900e-009
U14B	PLUTONIUM-239/240	PCI/G	.9893	3.4255	.2888	2.300e-010	3.800e-008	1.700e-011
U1A	PLUTONIUM-239/240	PCI/G	6.4680	3.4255	1.8882	2.300e-010	3.800e-008	1.700e-011
U1B	PLUTONIUM-239/240	PCI/G	2.6720	3.4255	.7800	2.300e-010	3.800e-008	1.700e-011
U2A	PLUTONIUM-239/240	PCI/G	3.5900	3.4255	1.0480	2.300e-010	3.800e-008	1.700e-011
U2B	PLUTONIUM-239/240	PCI/G	1.2190	3.4255	.3559	2.300e-010	3.800e-008	1.700e-011
U3A	AMERICIUM-241	PCI/G	.2792	2.3728	.1177	2.400e-010	3.200e-008	4.900e-009
U3A	PLUTONIUM-239/240	PCI/G	1.6960	3.4255	.4951	2.300e-010	3.800e-008	1.700e-011
U3B	AMERICIUM-241	PCI/G	.2602	2.3728	.1097	2.400e-010	3.200e-008	4.900e-009
U3B	PLUTONIUM-239/240	PCI/G	1.1900	3.4255	.3474	2.300e-010	3.800e-008	1.700e-011
U4	AMERICIUM-241	PCI/G	.0990	2.3728	.0417	2.400e-010	3.200e-008	4.900e-009
U4	PLUTONIUM-239/240	PCI/G	.1777	3.4255	.0519	2.300e-010	3.800e-008	1.700e-011
U5	AMERICIUM-241	PCI/G	.1176	2.3728	.0496	2.400e-010	3.200e-008	4.900e-009
U5	PLUTONIUM-239/240	PCI/G	.4119	3.4255	.1202	2.300e-010	3.800e-008	1.700e-011
U6	AMERICIUM-241	PCI/G	.1008	2.3728	.0425	2.400e-010	3.200e-008	4.900e-009
U6	PLUTONIUM-239/240	PCI/G	.4236	3.4255	.1237	2.300e-010	3.800e-008	1.700e-011
U7	AMERICIUM-241	PCI/G	.2677	2.3728	.1128	2.400e-010	3.200e-008	4.900e-009

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Based Concentration
SF = slope factor

Table D-1
Ratios of PCOC Concentration/Activities to RBCs
OU3 Surface Soil
Rocky Flats Plant

Location Code	Chemical Name	Unit	Max Result	RBC	PCOC Ratio	Oral SF	Inhal SF	Ext SF
U7	PLUTONIUM-239/240	PCI/G	1.1510	3.4255	.3360	2.300e-010	3.800e-008	1.700e-011
U8	AMERICIUM-241	PCI/G	.1500	2.3728	.0632	2.400e-010	3.200e-008	4.900e-009
U8	PLUTONIUM-239/240	PCI/G	.2009	3.4255	.0586	2.300e-010	3.800e-008	1.700e-011
U9	AMERICIUM-241	PCI/G	.3059	2.3728	.1289	2.400e-010	3.200e-008	4.900e-009
U9	PLUTONIUM-239/240	PCI/G	1.8570	3.4255	.5421	2.300e-010	3.800e-008	1.700e-011

Ext = External
Inhal = Inhalation
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk B[illegible] Concentration
SF = slope [illegible]r

Table D-2
Ratios of PCOC Concentration/Activities to RBCs
OU3 - IHSS 200 - Sediments and Groundwater
Rocky Flats Plant

Medium	Chemical Name	Unit	Max Result	RBC - C	RBC - NC	PCOC Ratio - C	PCOC Ratio - NC	Oral SF	Inhal SF	Ext SF	Oral RFD	Inhal RFD
GW	STRONTIUM	MG/L	5.5900		21.9000		.2553				6.000e-001	
SD	PLUTONIUM-239/240	PCI/G	4.0400	3.4255		1.1794		2.300e-010	3.800e-008	1.700e-011		
SD	COPPER	MG/KG	311.0000		11000.0000		.0283				4.000e-002	

C = carcinogenic
Ext = External
Inhal = Inhalation
MG/L = milligrams per liter
NC = non-carcinogenic
PCI/G = picocuries per gram
PCOC = Potential Chemical of Concern
RBC = Risk Based Concentration
RFD = reference dose
SF = slope factor

Appendix E
EVALUATION OF DERMAL CONTACT

APPENDIX E. EVALUATION OF DERMAL CONTACT

Appendix E contains results of the dermal contact evaluations for surface-soil Source Areas. As discussed in Section 6.0 of this document (Step 5 of the CDPHE Conservative Screen), any Source Areas that have Ratio Sums less than 1 require no further action by DOE, pending results of a dermal contact evaluation.

Dermal exposure to PCOCs in surface soil is not considered a significant exposure pathway for OU 3 because inorganic chemicals are not expected to be significantly absorbed through the skin (EPA, 1989a; EPA, 1992). As a screening step to support this assumption, maximum values for PCOCs in each Source Area that has a Ratio Sum less than 1 were compared to risk-based concentrations based on dermal contact (Dermal RBCs). Dermal RBCs were calculated using exposure parameters provided by EG&G (Table E-1).

All surface-soil Source Areas have ^{241}Am and $^{239/240}$Pu activities below the Dermal RBCs. (The maximum ^{241}Am activity for all Source Areas is 0.52 pCi/g and the ^{241}Am Dermal RBC is 273 pCi/g; the maximum $^{239/240}$Pu activity for all Source Areas is 6.47 pCi/g and the $^{239/240}$Pu Dermal RBC is 285 pCi/g.) Results of the screening step comparing measured activities of PCOCs in surface soil to Dermal RBCs confirm the assumption that dermal exposure is not a significant exposure pathway for OU 3.

Table E-1
Evaluation of Dermal Contact
Surface Soils

	Carcinogenic RBC				Non-Carcinogenic RBC	
Risk-based Concentrations	Organics and Metals		Radionuclides		Organics and Metals	
Dermal Exposure						
	[kg-day/mg]	[mg/kg]	[risk/pCi]	[pCi/g]	[mg/kg-day]	[mg/kg]
Chemical	SF	RBC-C	SF	RBC-C	RfD	RBC-NC
^{241}Am			2.40E-10	273		
$^{239/240}Pu$			2.30E-10	285		
^{238}U			1.60E-11	4091		
^{235}U			1.60E-11	4091		
$^{233/234}U$			1.60E-11	4091		
Aluminum	-				-	
Antimony	-				4.00E-04	2.01E+04
Arsenic	1.75	67			3.00E-04	1.51E+04
Barium	-				7.00E-02	3.51E+06
Beryllium	4.3	27			5.00E-03	2.51E+05
Cadmium	-				5.00E-04	2.51E+04
Chromium	-				5.00E-03	2.51E+05
Cobalt	-				-	
Copper	-				4.00E-02	2.01E+06
Cyanide	-				2.00E-02	1.00E+06
Manganese	-				5.00E-03	2.51E+05
Mercury	-				3.00E-04	1.51E+04
Molybdenum	-				5.00E-03	2.51E+05
Nickel	-				2.00E-02	1.00E+06
Selenium	-				5.00E-03	2.51E+05
Silver	-				5.00E-03	2.51E+05
Strontium	-				6.00E-01	3.01E+07
Tin	-				6.00E-01	3.01E+07
Vanadium	-				7.00E-03	3.51E+05
Zinc	-				3.00E-01	1.51E+07
RBC-C [pCi/g] = TR / (ED x SF x EF x SA x ABF x ADF x CF-r)						
RBC-C [mg/kg] = (TR x ATC x BW) / (ED x SF x EF x SA x ABF x ADF x CF-m)						
RBC-NC [mg/kg] = (THI x ATN x BW) / (ED x 1/RfD x EF x SA x ABF x ADF x CF-m)						
Dermal Contact with Surficial Soils (Residential Exposure Scenario)						
Target Risk	TR	1.0E-6	[-]			
Target Hazard Index	THI	1	[-]			
Surface Area	SA	2910	[cm^2] or [cm^2/event]			
Absorption Factor - Organics	ABFo	0.01	[-]			
Absorption Factor - Inorganics	ABFi	0.001	[-]			
Soil-to-Skin Adherence Factor	ADF	0.5	[mg/cm^2]			
Exposure Frequency	EF	350	[days/yr] or [events/yr]			
Exposure Duration	ED	30	[yr]			
Body Weight	BW	70	[kg]			
Averaging Time-C	ATC	25550	[days]			
Averaging Time-NC	ATN	10959	[days]			
Unit Conversion Factor - Rads	CF-r	1.0E-3	[g/mg]			
Unit Conversion Factor - Metals	CF-m	1.0E-6	[kg/mg]			

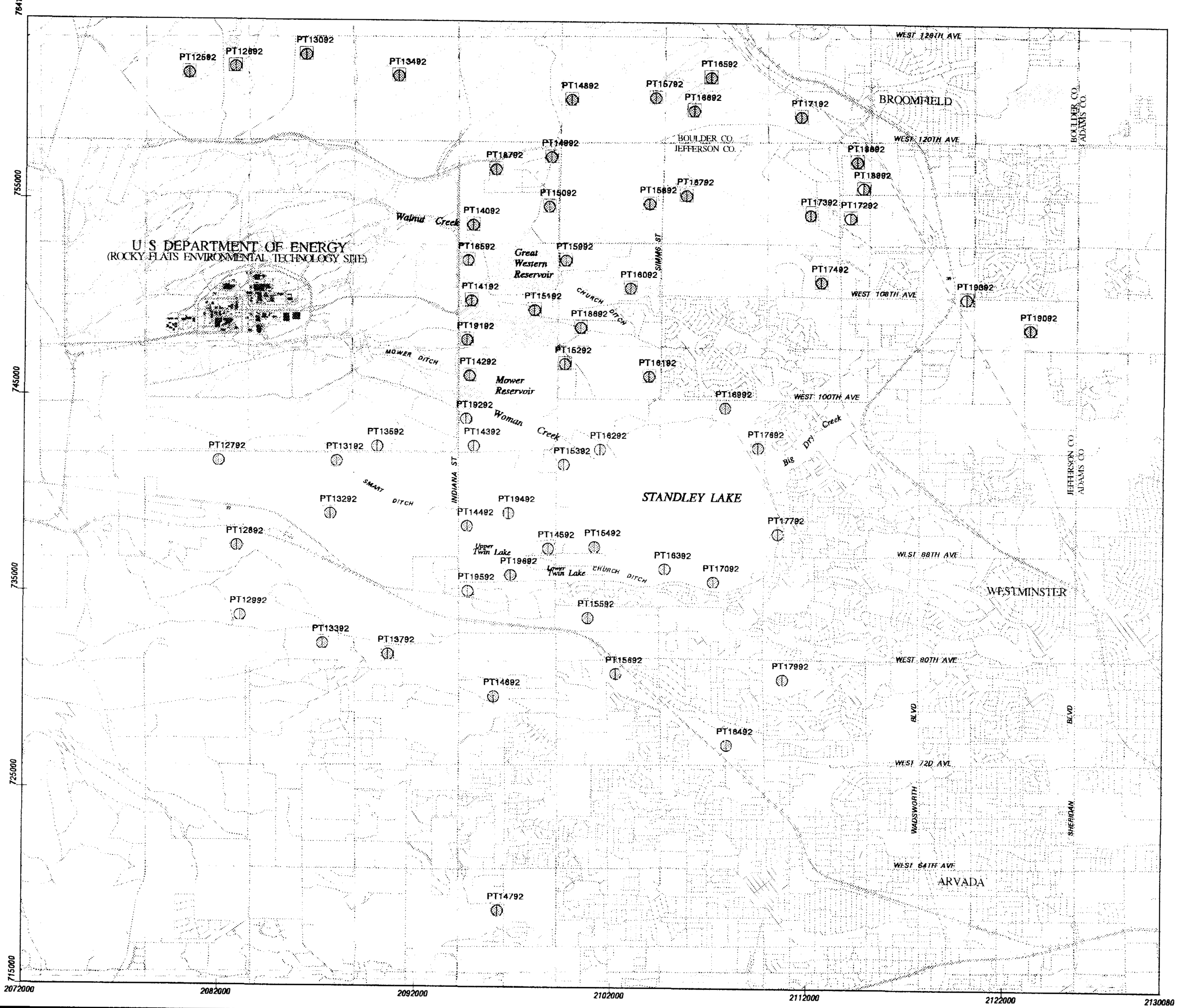


Figure 3-1
RFI/RI Surface Soil Plots
Surface Soils / Radionuclides

Ratios of 241Am and 239/240Pu to Background Levels

OPERABLE UNIT 3
IHSS 199 - Surface Soil Sampling Area
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
U.S. Department of Energy

Key to Symbols
241Am 239/240Pu

Key to Symbol Colors
Background Ratio (Comparison to background)
< 1 (Does not exceed background)
> 1 (Exceeds background)
Rejected Data

RFI/RI soil sample plot
untilled
tilled
Jefferson County Remedy Acres

The symbols show the ratios of each radionuclide (241Am and 239/240Pu) to the upper-bound background values (mean + 2 std dev).

Ratios are calculated using average values of CDH and RFP soil-sampling methods for RFI/RI plots, and maximum values for Jefferson County remedy acres. The circular symbols represent data collected within the soil sample plots; however, the placement of the symbol does not indicate the exact location of where a sample was taken. The reference levels (in pCi/g) used to calculate ratios are as follows:

REFERENCE LEVEL	241 Am	239/240 Pu
MEAN+2STD	0.04	0.09

Mapping Sources:
Jefferson County Mapping Dept.
EG&G Rocky Flats, Inc.
U.S. Geological Survey

N

Scale 1:63360
1 inch = 1 mile
0 0.5 1 2
MILES

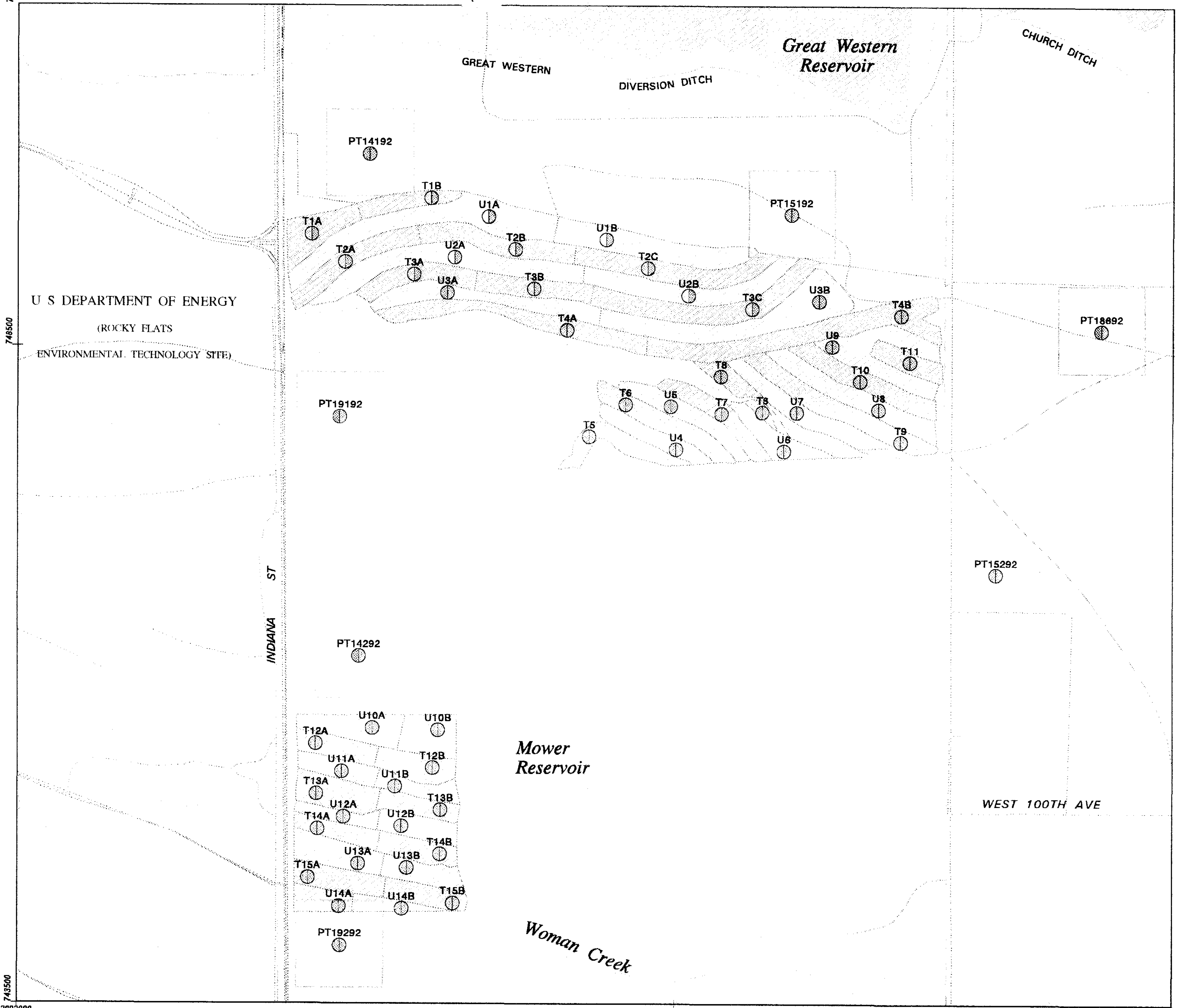
Polyconic projection. 1927 North American datum.
Colorado central zone state plane coordinate system.

MAP FILE NAME: CDH3-1.EPS
AML NAME: /PROJ/OU3/PLOTS/CDH-REPORT/CDH-SS.AML
Drawn by: D. Moreno
Approved by: J. Reynolds
September 20, 1994
CDH Conservative Screen Report Figure 3-1

A-OU02-00012

Figure 3-2
Jefferson County Remedy Acres Surface Soils / Radionuclides
Ratios of 241Am and 239/240Pu to Background Levels

OPERABLE UNIT 3
IHSS 199 - Surface Soil Sampling Area
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
U.S. Department of Energy



Key to Symbols
241Am 239/240Pu

Key to Symbol Colors
Background Ratio (Comparison to background)

- < 1 (Does not exceed background)
- > 1 (Exceeds background)
- Rejected Data

RFI/RI soil sample plot

untilled / tilled — Jefferson County Remedy Acres

The symbols show the ratios of each radionuclide (241Am and 239/240Pu) to the upper-bound background values (mean + 2 std dev).

Ratios are calculated using average values of CDH and RFP soil-sampling methods for RFI/RI plots, and maximum values for Jefferson County remedy acres. The circular symbols represent data collected within the soil sample plots; however, the placement of the symbol does not indicate the exact location of where a sample was taken. The reference levels (in pCi/g) used to calculate ratios are as follows:

REFERENCE LEVEL	241 Am	239/240 Pu
MEAN+2STD	0.04	0.09

Mapping Sources:
Jefferson County Mapping Dept.
EG&G Rocky Flats, Inc.
U.S. Geological Survey

N

Scale 1:9600
1 in = 800 ft
0 250 500 1000
SCALE IN FEET

Polyconic projection. 1927 North American datum.
Colorado central zone state plane coordinate system.

MAP FILE NAME: CDH3-2-C.EPS
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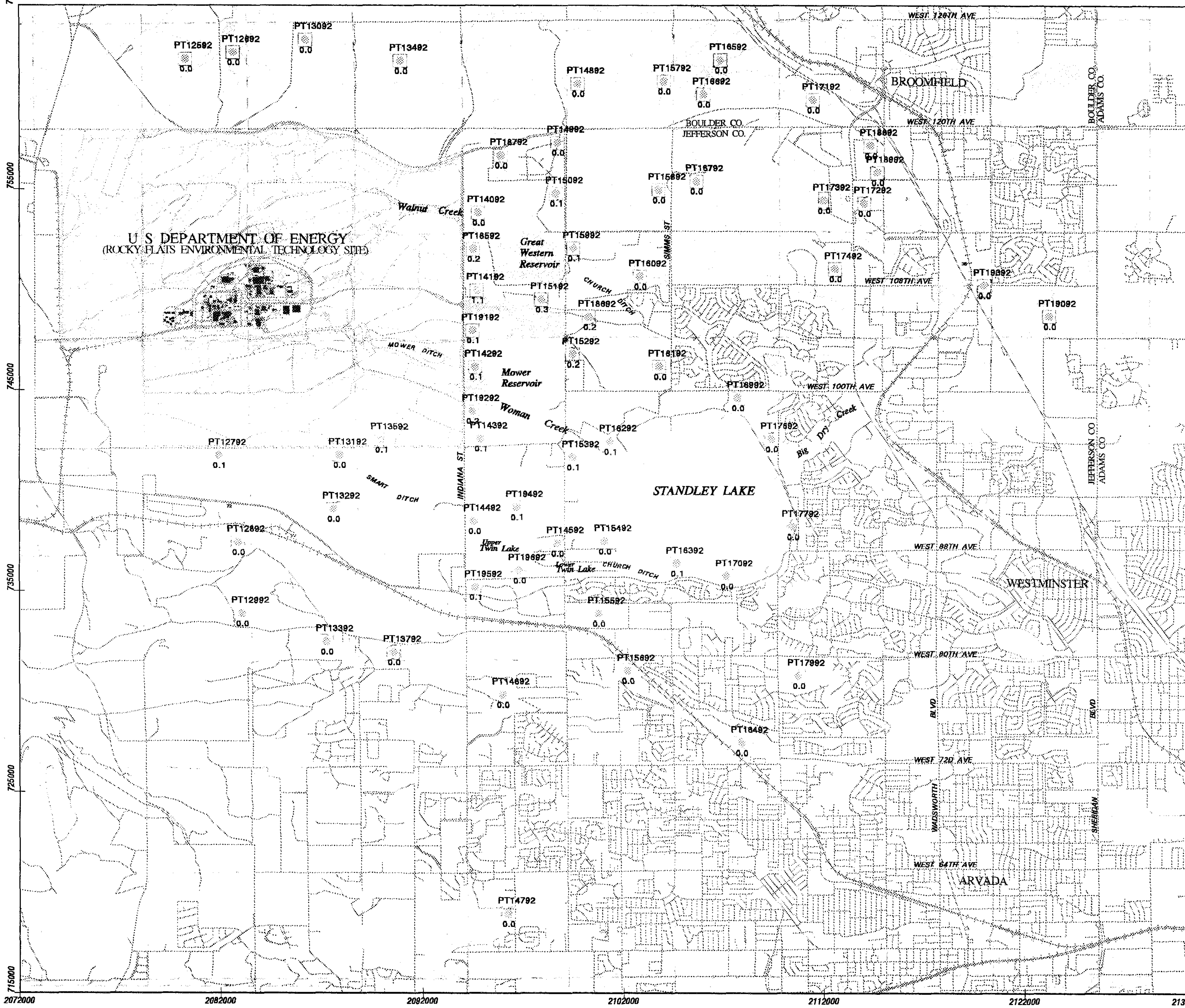
Drawn by: D. Moreno
Approved by: J. Reynolds
September 20, 1994
CDH Conservative Screen Report Figure 3-2

Figure 5-1
RFI/RI Surface Soil Plots
Surface Soils / Radionuclides
Ratios of 241Am and 239/240Pu to RBC Levels

OPERABLE UNIT 3
IHSS 199 - Surface Soil Sampling Area
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
U.S. Department of Energy



Key to Symbols

● 0.1 ← RBC Ratio Sum

Key to Symbol Colors

- Ratio Sum < 1
- Ratio Sum = 1 - 100
- Ratio Sum > 100
- Rejected Data

RFI/RI soil sample plot

untilled / tilled — Jefferson County Remedy Acres

The symbols show the ratio sums (sums of ratios of detected activities of each radionuclide to corresponding RBCs). (RBC = Risk-based concentration.)

Ratios are calculated using average values of CDH and RFP soil-sampling methods for RFI/RI plots, and maximum values for Jefferson County remedy acres. The circular symbols represent data collected within the soil sample plots; however, the placement of the symbol does not indicate the exact location of where a sample was taken. The reference levels (in pCi/g) used to calculate ratios are as follows: (see Table 5-1)

REFERENCE LEVEL	241 Am	239/240 Pu
RBC	2.37	3.43

Mapping Sources:
Jefferson County Mapping Dept.
EG&G Rocky Flats, Inc.
U.S. Geological Survey

Scale 1:63360
1 inch = 1 mile

0 0.5 1 2
MILES

N

Polyconic projection. 1927 North American datum.
Colorado central zone state plane coordinate system.

MAP FILE NAME: CDH5-1.EPS
AML NAME: /PROJ/OU3/PLOTS/CDH-REPORT/CDH-SS.AML

Drawn by: D. Moreno
Approved by: J. Reynolds

September 20, 1994

J Reynolds 9/20/94

CDH Conservative Screen Report Figure 5-1

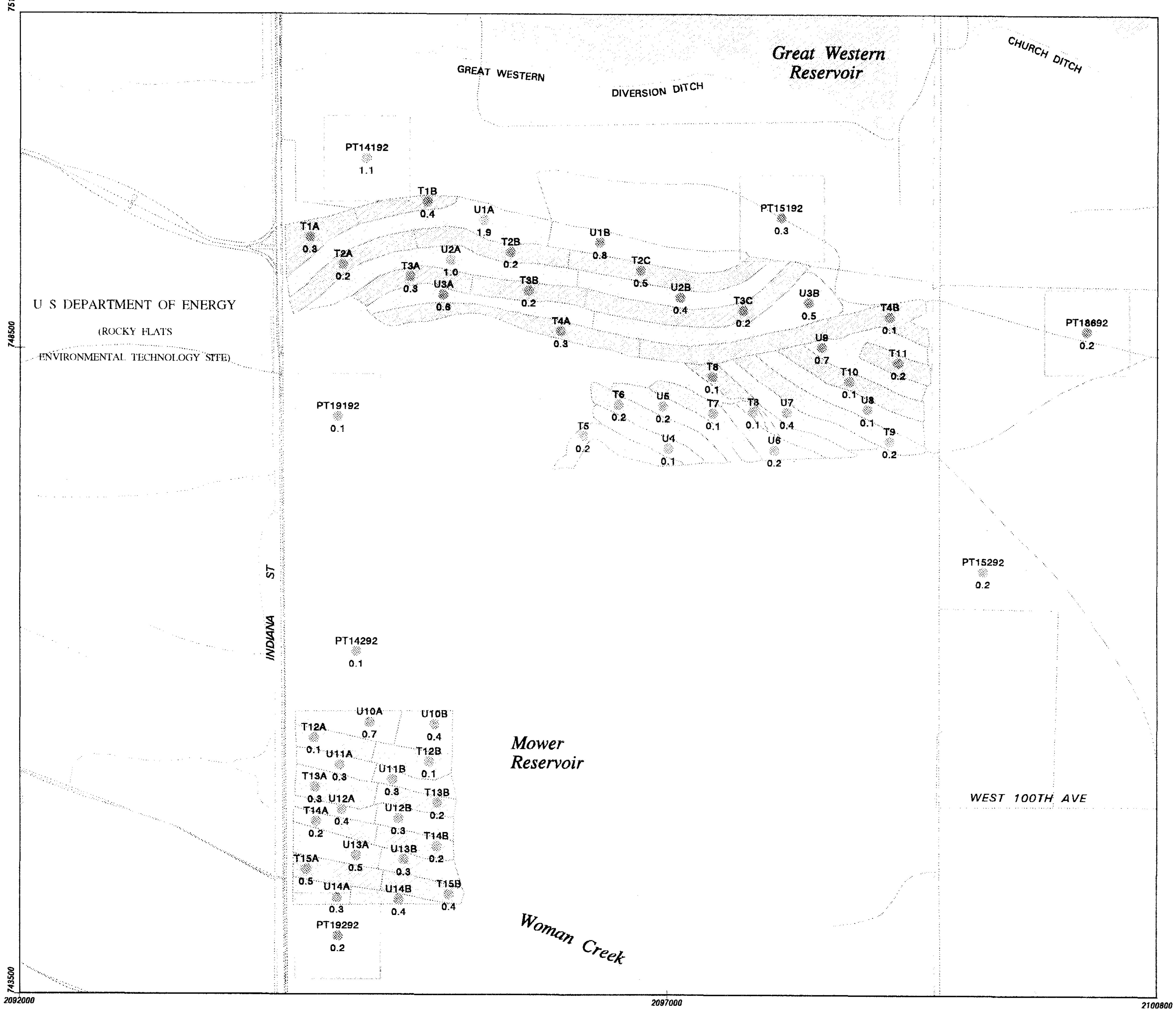


Figure 5-2
Jefferson County Remedy Acres Surface Soils / Radionuclides
Ratios of 241Am and 239/240Pu to RBC Levels

OPERABLE UNIT 3
IHSS 199 - Surface Soil Sampling Area
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
U.S. Department of Energy

Key to Symbols

0.1← RBC Ratio Sum

Key to Symbol Colors

Ratio Sum < 1
Ratio Sum = 1 - 100
Ratio Sum > 100
Rejected Data

RFI/RI soil sample plot

untilled
tilled
Jefferson County Remedy Acres

The symbols show the ratio sums (sums of ratios of detected activities of each radionuclide to corresponding RBCs). (RBC = Risk-based concentration.)

Ratios are calculated using average values of CDH and RFP soil-sampling methods for RFI/RI plots, and maximum values for Jefferson County remedy acres. The circular symbols represent data collected within the soil sample plots; however, the placement of the symbol does not indicate the exact location of where a sample was taken. The reference levels (in pCi/g) used to calculate ratios are as follows: (see Table 5-1)

REFERENCE LEVEL	241 Am	239/240 Pu
RBC	2.37	3.43

Mapping Sources:
Jefferson County Mapping Dept.
EG&G Rocky Flats, Inc.
U.S. Geological Survey

Scale 1:9600
1 in = 800 ft
0 250 500 1000
SCALE IN FEET

N

Polyconic projection. 1927 North American datum.
Colorado central zone state plane coordinate system.

MAP FILE NAME: CDH5-2-C.EPS
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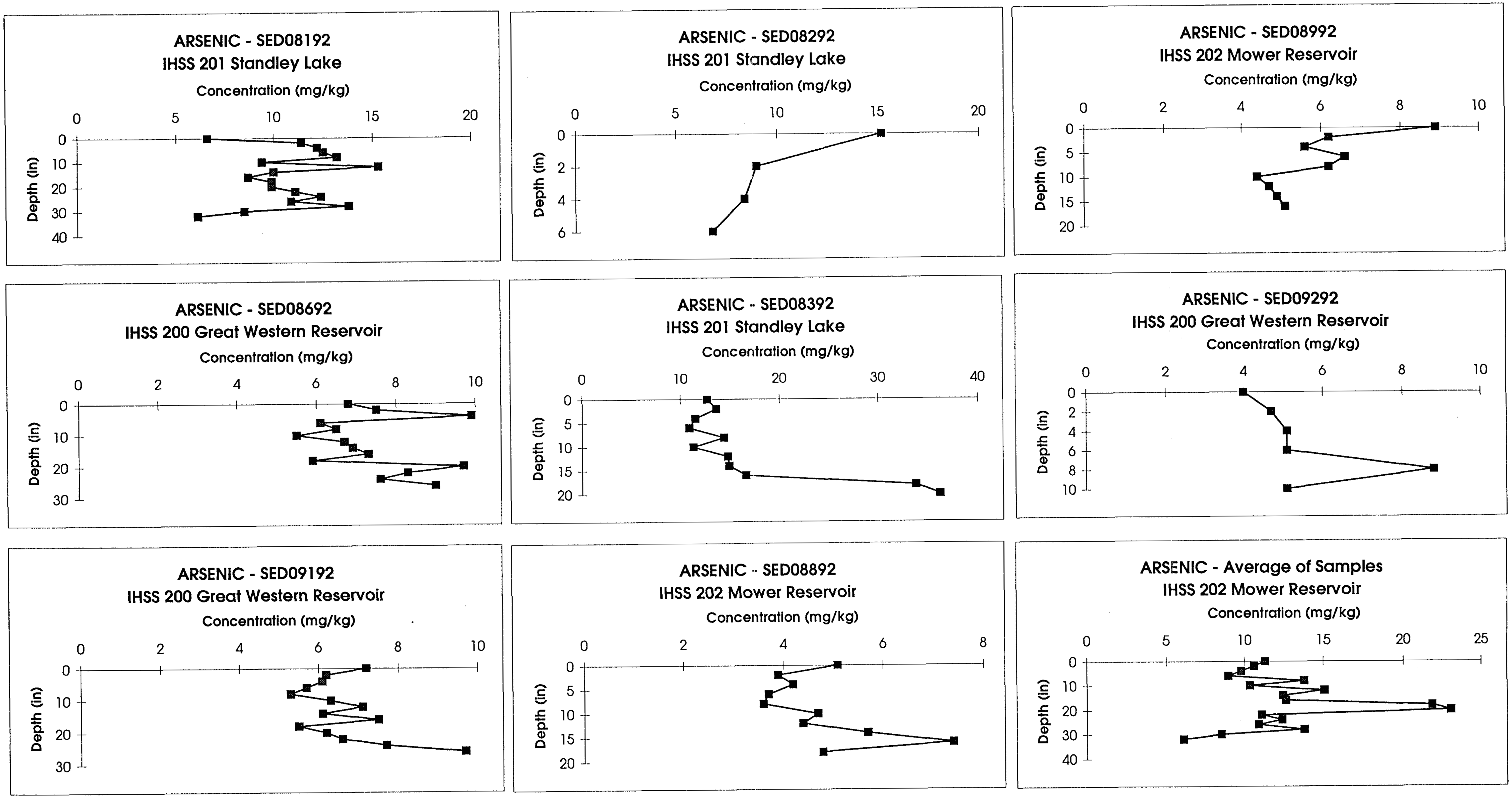
Drawn by: D. Moreno
Approved by: J. Reynolds
September 20, 1994
CDH Conservative Screen Report Figure 5-2



DEN156.XLS

Figure 3-7
ARSENIC CONCENTRATIONS IN SEDIMENT CORE PROFILES